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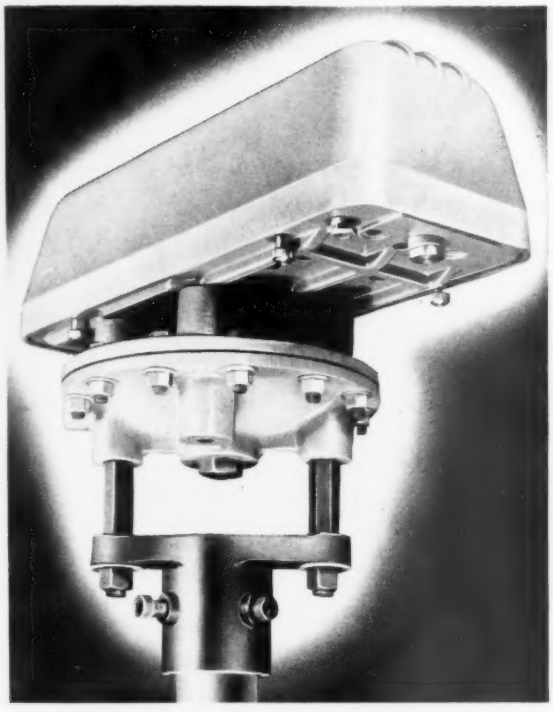

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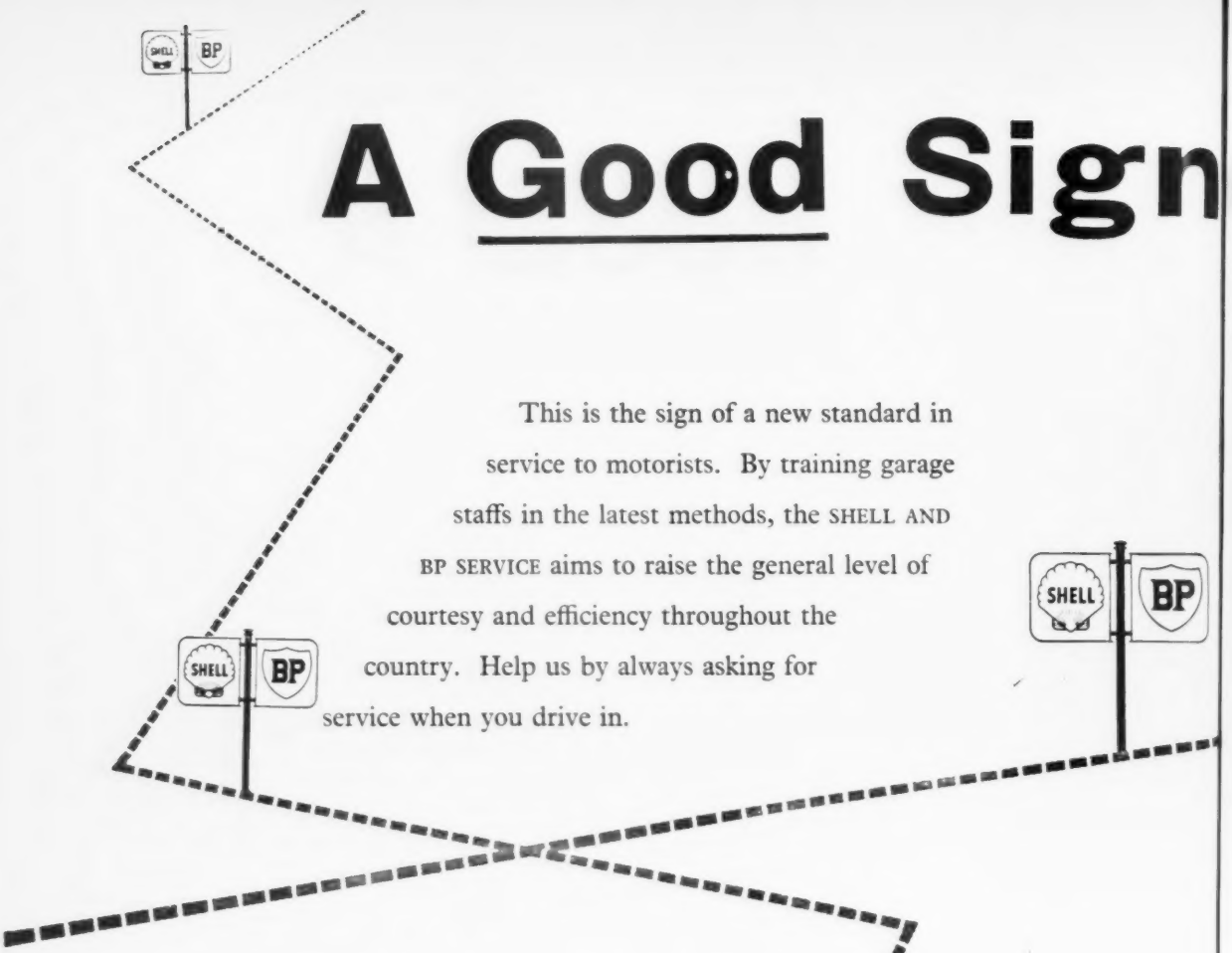

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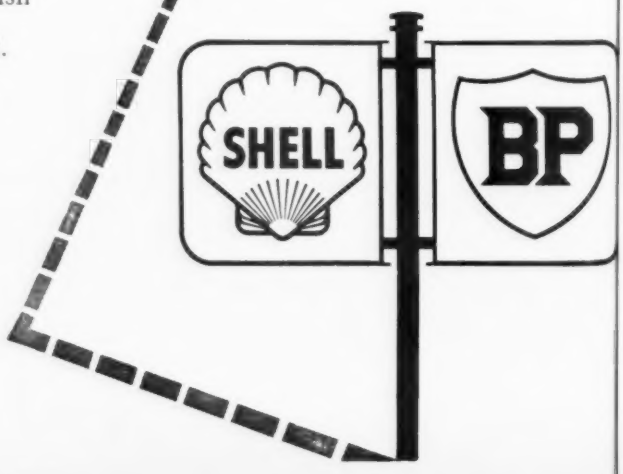

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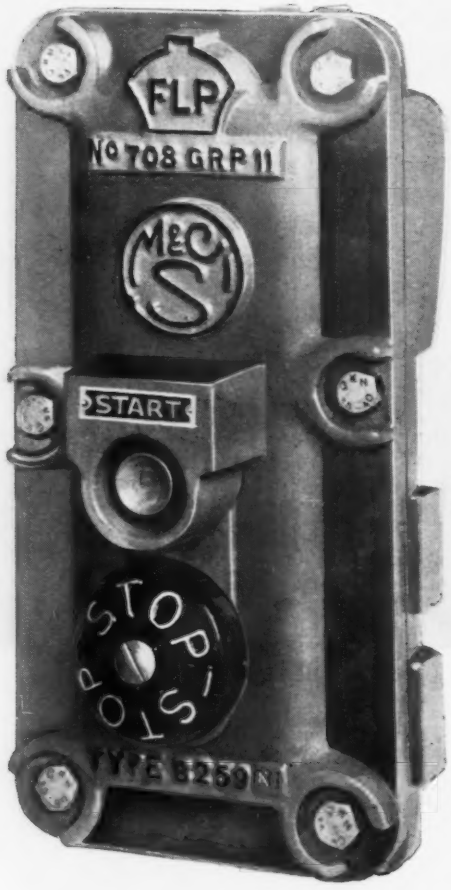

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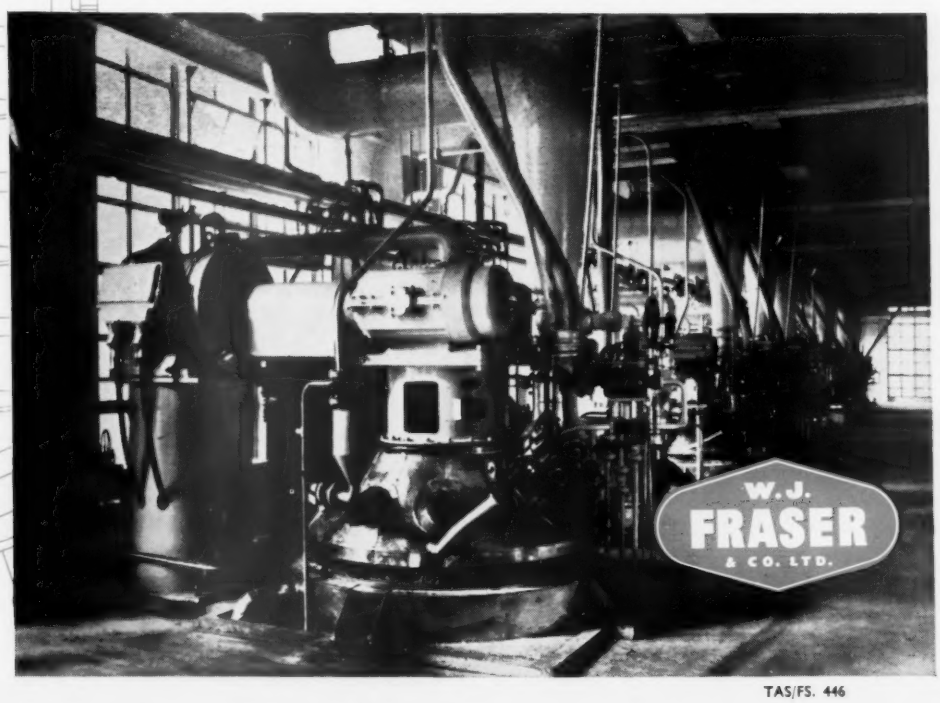

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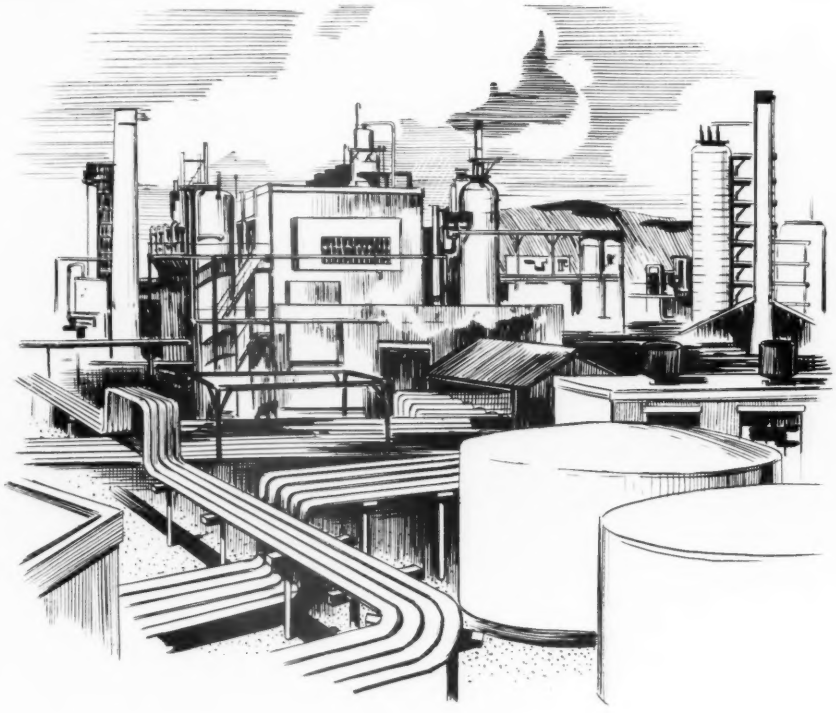

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Engine Design as Affected by Fuels and Lubricants*

By C. A. BEARD† *and* D. DOWNS†

PART I—THE SPARK IGNITION ENGINE

Introduction

The wide field covered by the title of this paper makes it impossible to do more than deal with some of the highlights of the subject and discuss the way in which the more important problems have arisen, their present status, and hopes for the future.

For the sake of convenience the discussion will be divided into three sections, dealing first with the petrol engine, then with the diesel, and lastly with aspects of lubricating oil performance which are common to both.

Combustion in the Spark Ignition Engine

The increase in spark-ignition engine power and efficiency over the years has been due to a simultaneous mastery over mechanical, metallurgical, and chemical problems, and it is not always easy to apportion the credit fairly between them. At times the fuel technologists have produced fuels, such as 100-octane aviation petrol, before the reliability of engines was such as to permit their full anti-knock value to be exploited. At other times the engine designer has run ahead of the fuel technologist and has had to limit the power of his engine because a fuel of sufficiently high anti-knock value was not available.

The efficiency of a spark-ignition engine is largely determined by the compression ratio at which it is possible to operate and this in turn is limited by knock. The first major improvements in engine performance which could be attributed to the influence of the fuel were the direct outcome of the realization that knock was associated with questions of fuel quality as well as with design features of the engine itself. After some preliminary work before and during the first world war, various workers, particularly Mr Harry Ricardo, as he was then, set out to study systematically both the tendency of various fuels to knock when run in a standard test engine and the effect of engine operating and design conditions on detonation.

It has been shown that in a normal combustion cycle the fuel-air mixture in the cylinder is ignited by the spark and a flame spreads from the spark plug to the farther side of the combustion chamber, burning the mixture as it goes and giving rise to a steady increase in pressure within the engine cylinder. The last part of the charge to burn is heated owing to compression by the expanding gases and by radiation from the advancing flame front. If the temperature and pressure conditions are sufficiently severe, the rate of chemical reaction will exceed a certain critical value and, just before the flame reaches the farther side of the combustion chamber, the unburnt or partially burnt mixture in the end-gas will be consumed at a very high rate. This high rate of burning and consequent momentary upset of the pressure equilibrium within the combustion chamber sets up a shock wave which, impinging on the cylinder wall, gives the high pitched knocking sound characteristic of detonation in an engine.

The occurrence of knock depends on the temperature–pressure–time relationships of the mixture in the end-gas. Thus any condition which raises its temperature or pressure, such as an increase in the compression ratio or the air intake temperature, or any condition which increases the physical and chemical induction time interval, such as an increase in the length of flame path or a lower engine speed (provided this does not affect other factors), will encourage knock.

It was soon found that fuels differed in their resistance to oxidation in the end-gas and consequently in their resistance to knock. The development of measuring techniques using variable compression engines, such as the Ricardo E.35 and E.6 units and the Co-operative Fuel Research or CFR engine, permitted the knock rating of the various fuels, both commercial grades and synthesized, chemically pure, fuels to be established. It was this latter work which enabled empirical rules to be devised linking the chemical structure of the fuel with its performance in the engine and so providing the guiding lines for the development of refining technique to improve fuel quality.

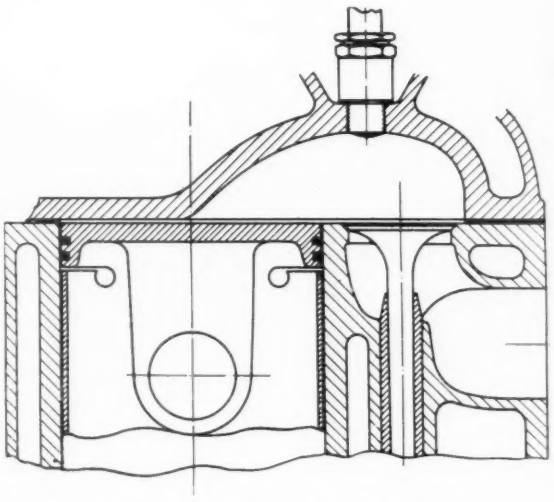

Fig 1. *Typical side-valve turbulent-head design.*

Combustion Chamber Design for the Spark Ignition Engine

So far as engine design is concerned this early work showed the importance of reducing the time interval available for chemical reactions to occur in the end-gas by reducing the maximum length of flame travel within the combustion chamber. This involved using the smallest possible combustion chamber and placing the spark plug as nearly as possible in the centre. It also showed the importance of ensuring that the end-gas had every possible facility for losing its heat, and

*Paper read to the Institute of Petroleum, London Branch, 1 April, 1954.

†Ricardo & Co. Engineers (1927) Ltd.

keeping the exhaust valve cool and as far as possible from the end-gases.

Two types of engine were developed, the overhead valve and the turbulent-head side valve. Of these the latter was often preferred from the manufacturing and maintenance point of view. In the turbulent head engine as developed by Ricardo[1], shown in Fig 1, the main body of the combustion chamber is concentrated over the valves, leaving a slightly restricted passageway communicating with the cylinder; thus additional turbulence is created during the compression stroke as the gases are forced through the passage. This, by speeding up combustion, improves the performance very considerably and at the same time renders the engine relatively insensitive to the timing of the spark. The effective length of flame travel is shortened by bringing the portion of the head which lies over the farther side of the piston into as close contact as possible with the piston crown. The thin layer of gas left between the piston and the cylinder head at top dead centre is kept sufficiently cool to avoid it being detonated.

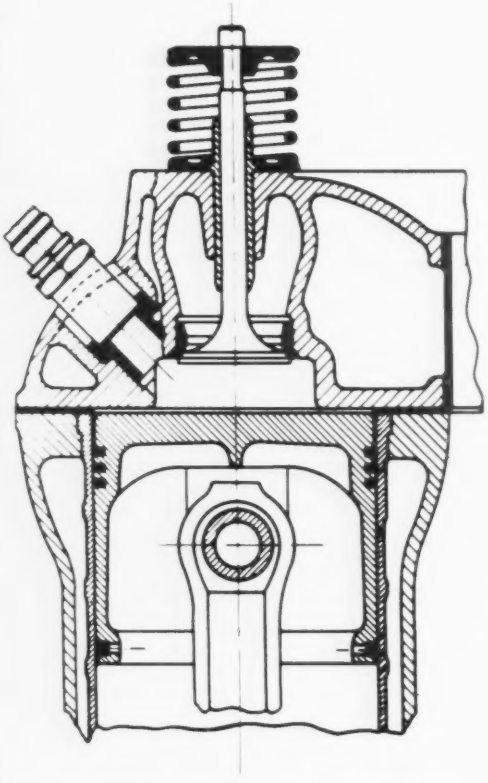

Fig 2. Typical "bath-tub" combustion chamber.

At the time that the turbulent head was developed the average octane number of petrol then available was in the region of 45 to 50 and the incidence of detonation limited the compression ratio of even the turbulent head to about 4·8. As the average octane number of petrol improved, the compression ratio was increased until by 1935 it had reached almost 6·0. At this ratio the normal spread of burning had increased so much that relatively little turbulence was required to give the optimum rate of pressure rise, about 30 to 35 p.s.i. per degree of crank angle. The turbulent head then tended to become over-turbulent and the rate of pressure too rapid, leading to harsh running and high heat losses. To combat this the area of the passageway was increased progressively, but with the very small total clearance volume available at a compression ratio of 6·0, this could be done only at the expense of closing down on the area round the valve heads or by restricting the size or lift of the valves; any one of which expedients involved reducing the breathing capacity of the engine. With the relatively high octane petrol available today it seems that the side valve engine can no longer compete with the overhead valve or other forms which permit the use of a compact combustion space without limiting the size of, or the free passageway round, the heads of the valves[1].

So far as overhead valve engines are concerned, particularly for those applications which call for a good all round but not an outstanding performance, the "bath-tub" type, with either vertical or inclined valves, provides a good compromise between performance and mechanical simplicity (Fig 2). An oval-shaped combustion chamber encloses the valves and the flanks of the oval overhang the cylinder bore, thus at the same time reducing the maximum length of flame travel and providing areas which may be used for "squish" to increase turbulence.

With this arrangement of combustion chamber in which the valves are placed in a single row along the cylinder head the breathing capacity of the engine is somewhat limited. For the optimum in engine power output, therefore, it becomes necessary to depart from a single row of valves, although this involves some added complication of valve gear. A very compact form of combustion chamber is that of the Rover[2]. The Jaguar engine has a hemispherical combustion chamber[3], the design of which has been influenced by the need for large valves with high lifts, together with the best possible gas flow into and away from the cylinder to permit operation at high speeds.

With the development of fuels of higher and higher octane number the possibility exists of increasing the compression ratio of petrol engines appreciably above their present figures. Although the average compression ratio of modern British cars is in the region of 7·0 to 7·5, some cars are on the market today with compression ratios of 8·0 and 8·5 and engines have been built experimentally with compression ratios as high as 12·5. The law relating power output and efficiency with compression ratio is, however, one of diminishing returns and there are some who say that the optimum has been reached at a figure around 8·0. Increases in compression ratio above this value would necessitate the use of scantlings and bearing areas such that the increase in friction loss would tend to outweigh the increase in indicated thermal efficiency. If compression ratios of this order are to be tolerated the question arises whether it would not be better to operate on the diesel cycle. This is a question which is very much under discussion at the moment, with the diesel engine tending to invade increasingly the field which used to be thought the domain of the petrol engine.

We probably know as much as we shall empirically about the influence of combustion chamber design on engine performance and can design an engine such that its knock tendency or octane requirement is at a minimum—when clean. That is an important qualification because in use an engine accumulates combustion chamber deposits owing to products of oxidation or partial oxidation of the fuel and lubricating oil, including the additives in both. These deposits give an octane requirement increase owing first to their volumetric effect, *i.e.* the increase in effective compression ratio to which they give rise; secondly to their thermal insulating effect, which by decreasing the heat transfer from the end-gas region promotes the knocking reactions, and thirdly to their direct chemical or catalytic effect on the end-gas chemical reactions. Glowing particles of deposit can cause pre-ignition, giving rise to knock—a phenomenon sometimes described as "wild ping". Enough has been said

to show that these deposits are undesirable. Effort is being expended from the petroleum side to reduce them and it may be that more attention could be devoted to seeking ways of designing combustion chambers to discourage the formation of these deposits. This might be done by suitable temperature control of selected areas of the combustion chamber or by control of turbulence within the combustion chamber to scour the deposits off the walls.

Mechanical Design of the Spark-Ignition Engine

An attempt is already made to improve the heat flow from the combustion chamber and most high performance engines today are fitted with water pumps providing about 15 gallons of water per hour for every horse-power developed. A

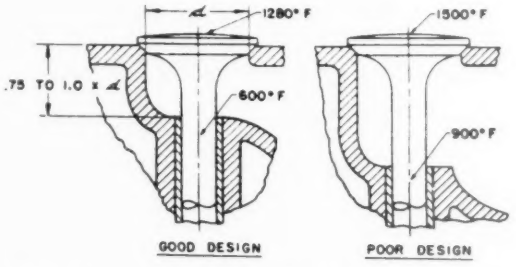

Fig 3. Comparison of good and bad exhaust port design.

thermostatically-controlled bypass valve permits rapid warming up with consequent reduction in cylinder bore wear. The outcome of this is that only a small temperature rise occurs between the water inlet and outlet and a high rate of heat transfer takes place owing to the high local velocities. This is increasingly augmented today by providing potential hot spots, such as valve seats, with directed jets of water, so ensuring that adequate coolant is present at the critical spots.

Improvements in valve materials, including sodium cooling of the larger exhaust valves and better cooling of valve guides, have led to a reduced tendency for pre-ignition or other troubles owing to hot exhaust valves. A better understanding of valve gear dynamics and reduction of valve seat distortion have also contributed to this.

The development of methods of measuring piston temperatures, such as the etching and Brinell recovery method when the physical properties of the piston material are known, the use of temperature plugs made of metal eutetics each having a certain definite melting point, or the more elaborate thermocouple arrangements, have led to considerable reduction in piston temperatures owing to improved transfer of heat to the cylinder liner. Of course, almost all high speed and high output engines now use light alloy pistons, usually of an alloy containing about 12 per cent silicon, to minimize the effects of the differing piston temperatures at full and part loads. Knowledge of temperatures together with the development of machine tools to turn pistons to a required degree of ovality and taper permits the use of the minimum practical clearances at full load.

These efforts to reduce engine temperatures and local hot spots have particular importance today when the increasing use of catalytic cracking processes in the refinery is producing fuels which are more adversely affected by high temperatures, *i.e.* are more temperature-sensitive, than straight-run gasolines.

The remarks made so far have applied particularly to the automobile engine. It is, however, with the aero engine that the demand for the highest possible output together with improved performance at high altitudes has brought the stiffest problems to the designer. High power was originally obtained by the use of high compression ratios in conjunction with high quality fuels. Perhaps the supreme example of this line of development was the Napier Lion engine which used a compression ratio of 10·0 in an engine of $5\frac{1}{2}$-in bore and $5\frac{1}{8}$-in stroke, operating at 2000 r.p.m. Experimental work on engines and the development of high efficiency superchargers showed that increased outputs could be obtained by using lower compression ratios but supplying the intake air at a pressure higher than atmospheric. The fact that the clearance space was to a large extent filled with fresh charge together with lower charge temperatures at the end of compression permitted higher outputs to be obtained before the onset of detonation limited further gain. For high outputs for short periods, such as for aircraft take-off, very rich mixture strengths, perhaps with the injection of water or methanol–water, may be used[4]. The reduction in charge temperature owing to the latent heat of vaporization of the excess fuel or water reduces the tendency to detonate as also does the presence of high-octane methanol.

The Use of Tetraethyl Lead as a Fuel Additive

The steady improvement in the octane number of both automobile and aircraft engine fuels during the past three decades has been brought about partly by new and improved refining techniques and partly by the use of tetraethyl lead as a fuel anti-knock additive. The latter is so effective that today it is used in practically all gasolines. Although the quantities added are small, about 5·5 cc/I.G. are used in aviation spirit and, in the U.K. 1·5 to 1·8 cc/I.G. in automotive fuel, the deposits left behind on combustion of the additive are sufficient to cause considerable trouble if precautions are not taken to cope with them.

If added alone to the fuel, tetraethyl lead would burn to give lead oxide and lead oxysulphate, the sulphur coming from impurity in the fuel. In practice tetraethyl lead is added in the form of Ethyl fluid in which the tetraethyl lead is blended with a halide, ethylene dibromide in the case of aviation fuel,

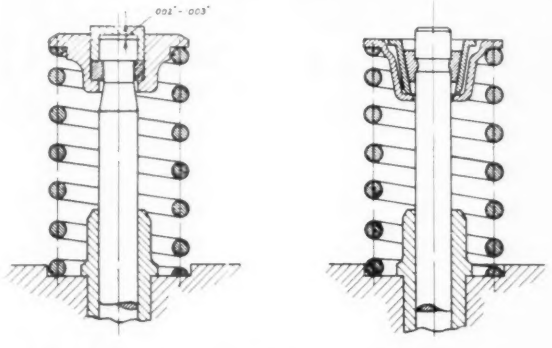

Fig 4. Valve rotators of (a) Eaton and (b) Ford design.

and a mixture of ethylene dibromide and ethylene dichloride in the case of automotive fuel. The object of these additives is to convert the lead oxide into the more volatile halides which would be more likely to pass harmlessly out through the exhaust. In practice these lead scavengers, as they are called, are not completely effective and a lead deposit does accumulate in the combustion chamber, usually in the form of lead oxide, oxysulphate, or oxyhalide on the relatively hot surfaces such as the exhaust valve and spark plug insulator, and as lead bromide combined with carbonaceous matter on the cooler combustion chamber walls. Apart from the effect this deposit has on octane requirement and power loss, mentioned earlier, it has its greatest effect on the spark plug and on the exhaust valve.

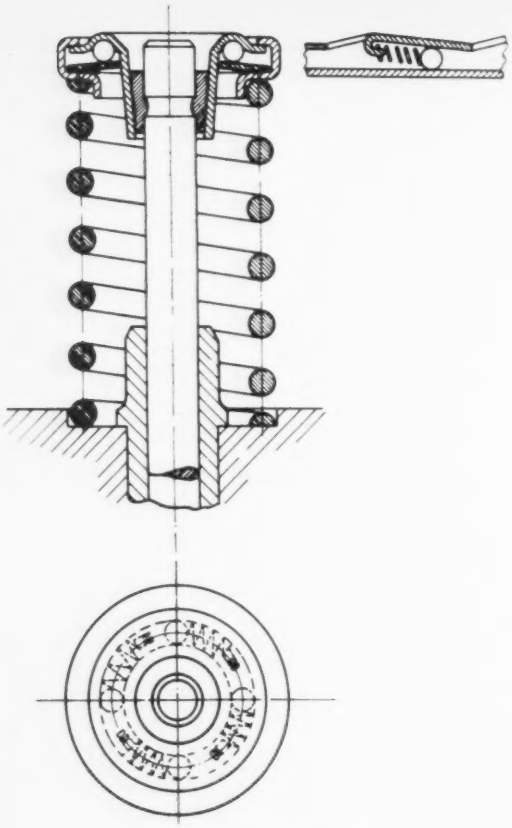

Fig 5. The Thompson Rotocap.

So far as the exhaust valve is concerned failure may show itself in one of several ways. A common cause of trouble is sticking of the valve in its guide owing to deposits forming on the stem and sticking the valve open. This can be combated to a large degree by correct exhaust port design (Fig 3)[5]. The coolant should be brought as close to the valve head as possible to provide maximum cooling of the valve. The guide should not protrude into the port and it is sometimes helpful to counterbore the guide $\frac{1}{16}$ of an inch on the diameter for a distance slightly greater than the valve lift, to ensure that material deposited on the stem while the valve is open does not jam in the guide when the valve is closing.

If the valve runs sufficiently hot, corrosive attack of the crown by lead can occur but this is more likely under aircraft conditions than in an automobile engine. In the latter it is more usual for deposits to build up on the valve seat and then break away in a small patch allowing gas to escape across the seat. The resulting increase in valve temperature can rapidly lead to a local guttering failure. A similar type of failure can occur owing to a piece of deposit breaking away from the combustion chamber walls and jamming between the valve and its seat on its way out of the cylinder. In this case gas blow can occur over nearly the whole of the valve circumference. Valve seat distortion owing to uneven cooling of the valve deck is another cause of this type of failure. This can be combated by improved valve and valve seat design and by the use of valve steels having improved hot strength, hot hardness, and corrosion resistance. A few years ago the almost universal valve steel was Silchrome 1 (EN52), but this is rapidly being replaced by XB (EN59), and in the U.S.A. by XCR.

In most cases improved valve and port design and improved valve materials will enable a reasonable valve life to be obtained on present-day U.K. commercial fuels. For sustained high-duty operation or with more highly leaded fuels, such as may be encountered overseas or under service conditions, further steps may be necessary. A useful method of prolonging valve life is to cause the valve to rotate so that it does not seat always in the same angular position. Three types of rotator at present in use are illustrated here[6]. Fig 4 shows the "Free-Release" type made by The Eaton Manufacturing Company. In this design the last few thousandths of an inch of valve closure release the valve from the restraint of the spring. Since there is some "wind-up" in the spring the release of the spring load results in a small degree of free angular movement of the valve owing to its inertia. The second type, patented by the Ford Motor Company, is generally similar but valve movement is obtained not by releasing the spring load entirely but by reducing the frictional torque between the valve and the spring to such a value that the rotational energy in the valve owing to spring "wind-up" can overcome the frictional restraint, so permitting limited valve rotation with respect to its seat. Fig 5 shows a rotator, developed by Thompson Products, which has a positive angular movement as a result of the movement of the balls down the inclined planes.

The use of valve rotators has in some cases enabled engine life before valve failure to be increased by some hundreds per cent. Valve rotation does, however, increase valve seat wear in some cases, thus necessitating the use of a hard facing alloy, such as Stellite or Eatonite, applied by welding.

In the aircraft engine, where valve cooling problems are in general more acute than they are in automobile engines, sodium cooling has long been adopted. More recently this has been applied to high-duty road vehicle engines.

Mixture Distribution

A further item of engine design where the fuel and engine characteristics are closely interrelated is the induction manifold. Even today the correct design of a manifold to ensure even distribution of fuel between the cylinders of a multi-cylinder engine is more an art than a science. In cases where by good luck or by good design even distribution has been

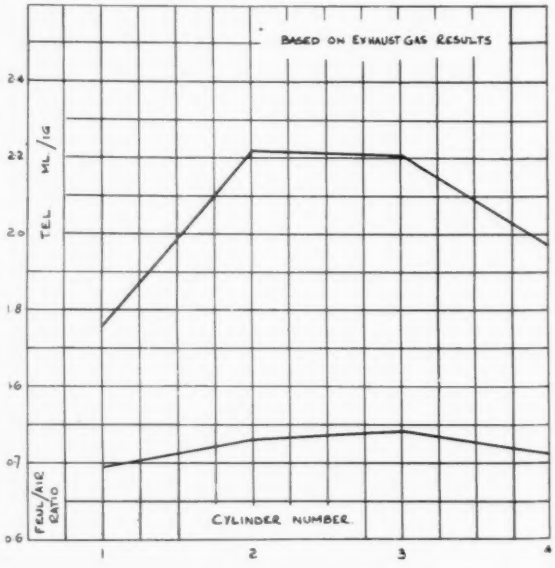

Fig 6. Fuel and lead distribution between engine cylinders.

achieved, thus enabling the most economical mixture to be used in all cylinders, an improved fuel consumption may be obtained. In addition to correct manifold configuration, manifold heating, either by the coolant or by the exhaust gas, can assist the vaporization and distribution of heavy ends of the fuel. Direct injection of the fuel to each cylinder, while efficacious from the point of view of distribution, is in most cases not worth the additional cost of equipment.

Tetraethyl lead, having a boiling point which puts it among the heavy ends of petrol, tends to be even worse distributed than the bulk of the fuel. Fig 6 shows some typical figures obtained on a four-cylinder road vehicle engine in which the fuel distribution variation was some 5 per cent but the lead distribution was 40 per cent[7]. This maldistribution, which results in much higher lead concentration reaching some cylinders than others, aggravates, of course, the valve failure, spark plug fouling, and deposit troubles caused by lead. A small piece of deposit thrown up by the deflector piston may, for example, be sufficient to bridge the gap in the spark plug of a two-stroke engine and cause engine failure after only a few hours operation. Not all the deposits are electrically conducting however, and it has been known for a spark plug from a relatively light duty water-cooled four-stroke engine to be functioning satisfactorily after 1000 hours operation, despite the fact that the gas space was almost completely filled with deposit.

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Trinidad Petroleum Industry in 1953

The year 1953 was a year of new records in the oil industry of Trinidad as shown by W. N. Forster, Trinidad's Petroleum Technologist, in his annual report to the Colonial Secretary.* A record crude oil production figure of 22,345,923 barrels was reached and also a new refinery input figure of 37,446,038 barrels. In addition to this progress in the oil industry, 1953 was also notable for the foundation of a petrochemicals industry in Trinidad.

Drilling and Exploration

An average of 27 drilling rigs were in operation during the year, one less than in 1952, but the total footage drilled amounted to 917,894 ft—a substantial increase on 1952 when the total footage was 736,535. New wells started during the year numbered 223, 224 wells were completed, and 13 were abandoned during drilling.

Seismograph surveying continued during 1953. Seven lines were run in the Siparia district, three in the Moruga-Bouffe district and four in the Palo Seco and Erin areas. Seismic surveys were completed in the Ortoire district and a number of other surveys were continued. A detailed marine seismic survey was undertaken by Dominion Oil Ltd. in the northern part of the Gulf of Paria and there was also a reconnaissance seismic survey of the marine area off the East Coast held under licence by that Company.

Twelve wells were drilled by U.B.O.T. Ltd. in the Herrera sands and work was begun on the construction of a 32-inch pipeline.

Oil Production

The total crude oil production of 22,345,923 barrels represented an increase of 5 per cent over the previous year, and an average daily production figure was reached of 24.1 b.d. per producing well. Of the average of 2536 producing wells, 639 were flowing, 133 were under gas or air lift, 1477 were pumped, 240 were on plunger lift, and 47 were produced by other methods.

* Administration Report of the Petroleum Department for the year 1953. Govt. Printing Office, Trinidad, 1954, 81.20.

Refining

As already stated, a new refinery input record of 37,446,038 barrels was reached in 1953—an increase of nearly 4 per cent over 1952.

Petrochemicals

Steps were taken during 1953 to develop a petroleum chemical industry in Trinidad, with the hope that it will develop there on the same lines as in the U.S.A. where it now supplies 25 per cent of the country's entire chemical consumption. With this end in view a new company, Trinidad Leaseholds Chemicals Ltd., was formed in December 1953 for the purpose of manufacturing petroleum chemicals. This subsidiary company rents and operates certain plants owned by Trinidad Leaseholds Ltd., two of which were specially built during 1953. One of these is for the manufacture of granulated sulphur, used for the production of sulphuric acid, and the other is for the manufacture of di*iso*butylene for the plastics industry. Another plant has been modified to produce propylene tetramer for use in the manufacture of soapless detergents.

During 1953 initial shipments were made of all these products.

Natural Gas

Production of natural gas increased by approximately 10 per cent over 1952, largely owing to the 5 per cent increase in crude oil production and to an increase in the proportion of flowing crude oil production.

The Asphalt Industry

A total of 143,342 tons of natural asphalt was extracted from the Pitch Lake during 1953.

Contribution to Revenue

Revenue paid by the oil industry during the year amounted to 25.6 million dollars, and a further 54 million dollars was paid out locally in wages, purchases, and other expenditure.

Excise duty amounting to 1,709,321 dollars was paid by the general public on purchases of gasoline.

Around the Branches

FAWLEY, LONDON, NORTHERN, PERSIAN GULF, SCOTTISH, SOUTH-EASTERN, SOUTH WALES, STANLOW, TRINIDAD

Fawley Branch

At a meeting of the Branch on 19 November 1954 T. B. Webb, B.Sc., M.I.Mech.E., M.A.S.M.E., gave an interesting lecture on the design and manufacture of welded pressure vessels.

The speaker dealt first of all with the various stages of manufacture of large pressure vessels, and this was illustrated by a film which showed details of the work normally carried out in modern workshops devoted to the construction of these vessels. Particular emphasis was given to the need for good preparatory work. The film showed the remarkable uniformity that can be obtained by modern welding techniques, using equipment such as the automatic multi-layer machines and machines for welding by the submerged arc process. Finally, the latest developments in stress relieving and testing techniques were shown.

Mr Webb postulated that it was the aim of the designer and constructor to produce a vessel which would not fail under any of the various stresses to which it could be subjected and yet was not in any way thicker or heavier than was really necessary. Possible ways in which a vessel could fail were examined by the speaker, together with the properties of the material required to resist the various forms of failure. Emphasis was laid on the desirability of avoiding stress raisers in the design which might create localized weaknesses in the vessel.

Mr Webb spoke of the difficulty of assessing the results of tests on materials and designs to decide what the effect of prolonged actual service would be, and coupled this with a concluding remark that there was a great need for authoritative case histories on plants which had operated over long periods, to give that combination of service experience and experiment which would enable design to continue to make real progress.

The discussion which followed brought out further points of interest to all present. In particular, discussion centred upon methods of heat treatment, the desirability of plasticity in the metal, and the possibility of increasing the length of the normal run of a modern boiler plant.

A vote of thanks to Mr Webb was proposed by N. B. Smethurst.

Persian Gulf Branch—Bahrain Sub-Area

The 30th general meeting of the Bahrain Sub-Area of the Branch was held in Awali on 4 December 1954. There was a good attendance of members and their guests to hear B. J. Ruddick, the guest speaker, deliver a talk on "Some Aspects of Corrosion in the Petroleum Industry".

The speaker, who is a senior member of the Inspection Department of the Bahrain Petroleum Company, was introduced by the Chairman, W. H. Cotter. Mr Ruddick prefaced his talk by showing the International Nickel Company's film, "Corrosion in Action". This film gives an excellent insight into various types of corrosion and shows how certain metals or alloys can slow down this wasteful process to negligible proportions. The film also illustrates that corrosion is much more active when metals further apart in the galvanic series are brought into contact.

At the conclusion of the film, Mr Ruddick began his talk by listing the various types of corrosion that had been noted, and he then went on to amplify this list in considerable detail. The latter part of his paper dealt with aspects of corrosion found in the Bahrain refinery and the types of metals or alloys used in the several units of the refinery to reduce this undesirable activity.

The speaker then introduced a panel of gentlemen who were to assist him in answering questions or to comment on any matter which might arise when the meeting was open to discussion. This panel consisted of B. B. Morton of the International Nickel Company, F. W. B. Harris, engineering manager, and I. E. Bosher and D. Wilkinson of the Inspection Department of the Bahrain Petroleum Company Ltd. The discussion proved most lively and interesting, some members or guests contesting the relative merits of certain alloys in combating corrosion under selected conditions, while others related their observations of unusual types of corrosion and asked into which sections of Mr Ruddick's list these would fall. There was also a lively debate on the respective merits of organic and inorganic inhibitors.

At the conclusion of the discussion, Mr Morton outlined some of the recent research that his Company had been engaged in with respect to unusual corrosion problems. Mr Ruddick then thanked the panel for their assistance and the meeting closed after the Chairman had expressed his thanks to the Bahrain Petroleum Company Ltd. for the use of the hall and facilities.

Formation of Bahrain Branch

At a meeting of the Branch held on 17 January the following resolution was put to the meeting and accepted:—

That a Branch of the Institute be established in Bahrain; such Branch to take over from the present Bahrain Sub-Area of the Persian Gulf Branch all Institute functions previously carried out by the Bahrain Sub-Area and to perform any other functions appropriate to a Branch of the Institute.

The Council of the Institute has been asked to approve this new Branch.

The meeting was followed by a film show.

Scottish Branch

The annual general meeting of the Branch was held in the North British Station Hotel, Edinburgh, on 13 January. Dr G. H. Smith, Honorary Treasurer, presided. Professor H. B. Nisbet, R. Crichton, J. W. Pirie, and G. Peters were re-elected to the committee. G. Dewar and G. Fleming were re-elected auditors.

Dr Smith in introducing J. McLaren, the lecturer, said that he was well qualified to speak on the subject of "Plant Inspection". Mr McLaren has been chief plant inspector at Grangemouth refinery since 1951.

Mr McLaren opened his lecture by drawing attention to the fact that equipment in oil refinery service was subject to the wasting effects of heat, chemical attack, and abrasion, and yet it must remain in service for long periods and be perfectly safe under these conditions.

Maintaining equipment to the high standard necessary was dependent on making repairs or installing replacements at times when plants were shut down. Assessing the condition of equipment at off-stream times was the main task of the plant inspection department.

Production requirements and difficulties associated with shutting down one plant without seriously affecting others, made it essential to plan shut-downs. The run period between these shut-downs was governed mainly by equipment wastage rates, and inspection of equipment was largely carried out to determine these rates.

The Factories Acts, said Mr McLaren, laid down that steam boilers, air vessels, etc., must be examined at set periods, and a certain standard of examination must be carried out. There were no such rules for oil refinery equipment which often operated under more severe conditions than the items for which legal provision was made. Oil refining companies, however, had made their own rules and set their own standards and these were briefly explained by Mr McLaren.

Before an assessment could be made of the condition of any equipment it was essential to know its original design requirements, and all details of design, such as pressure and temperature rating, wastage allowances, etc., had to be gathered together. Mr McLaren spoke first of what constituted satisfactory initial information, and then went on to describe some of the tools used by plant inspectors. These tools vary from an ordinary hand hammer to special electrical and electronic devices for determining the thickness of the metal of a vessel from the outside without opening the vessel. The speaker emphasized that alert visual inspection was necessary at all times and that the most useful inspection tool was the inspector's hand hammer.

Mr McLaren took three examples to illustrate the inspection of equipment: heaters, multitubulars, and general pipework, and spoke of the various troubles which arise with these types of equipment, methods of diagnosing trouble, and the action taken when the faults had been found. Some information was also given on how suitable records are kept so that information on the wastage of all pieces of equipment is readily available.

After the lecture a very interesting discussion took place, and at the close of the meeting Mr McLaren was accorded a very hearty vote of thanks.

South-Eastern Branch

The annual general meeting of the Branch, which was to have been held on 4 January, met with bad luck in regard to the weather. Nearly 6 inches of snow fell during the afternoon and as a result it was not surprising that only nineteen people arrived for the meeting, not enough to form a quorum.

It was decided, however, that although the annual general meeting must be abandoned the rest of the evening's programme should continue.

A film entitled "The Tower", illustrating the second stage in the building of the Isle of Grain Refinery, was shown, and after this a supper consisting of hot sausages and sausage rolls was handed round. Following this, the Brains Trust planned for the evening was held, although only two of the members of the panel, Dr Carruthers and Mr Grey, were able to be there. In spite of this, ten questions were asked and answered in a most interesting manner, and because of the small attendance at the meeting a very intimate atmosphere prevailed. So much so that it was not until 10.0 p.m. that the meeting closed, everyone feeling that it had been well worth while to continue with the arrangements in defiance of the weather conditions.

Stanlow Branch

On 14 December last year a joint meeting was held with the Liverpool and North West Section of the Royal Institute of Chemistry.

A lecture was given by Dr E. S. Paice of Shell Chemicals Ltd. entitled "Chemicals from Petroleum: the Growth of a New Industry".

The speaker traced the growth of the petrochemical industry from approximately 1930 onwards, and outlined the main products obtained from the ethylene, propylene, and butylene gases.

The impact of petroleum-derived detergents on the soap market was discussed by the speaker, and also the production of pure aromatics from petroleum sources.

The lecture ended with a short survey of the work of the various companies in the U.K. which are active in the petroleum chemicals field.

The discussion was opened by Dr C. B. Davies and at the close of the meeting a vote of thanks was proposed by Mr Meyer of the Royal Institute of Chemistry and seconded by H. L. Sturgess.

Trinidad Branch

The 139th general meeting of the Branch was held at the Pointe-a-Pierre Club-House of Trinidad Leaseholds Ltd. on 8 October 1954, with the Branch Chairman, Dr A. L. Down, presiding.

A. N. T. Bennett gave an introductory talk on "Cathodic Protection". He began by stating that among the many factors governing materials selection in the oil industry were corrosion rates, mechanical properties, required service life, cost of installation, repair, and replacement. The most economic materials were seldom the most corrosion-resistant and the use of protective coatings, corrosion inhibitors, cathodic and other means of corrosion protection, had also to be considered. All were in general use, said Mr Bennett, but as cathodic protection had gained rapidly in popularity in the past few years, he would give examples of its applications and discuss the principles of designing a scheme of cathodic protection.

Mr Bennett then described briefly the two basic methods of cathodic protection: (*a*) the use of zinc or magnesium as sacrificial anodes, and (*b*) the use of impressed direct current with graphite or scrap steel as anode.

Finally, he stressed the need for potential checks after installation, which frequently showed up errors in design. These, however, were usually small enough to be easily rectified, *e.g.*, by the installation of a few additional magnesium anodes, by increasing rectifier output, or by reducing the losses in interconnecting cables.

Then followed a most interesting film, "Corrosion in Action", which had been produced and loaned by the International Nickel Company by arrangements made through their United Kingdom associates, Henry Wiggin and Co. Ltd. The film paid tribute to Sir Humphrey Davy, Michael Faraday, and others for their original researches into galvanic action and very clearly demonstrated the electrochemical nature of corrosion.

A lively discussion ensued in which tribute was paid to the high standard of the film and the clarity with which the subject had been presented.

Votes of thanks to Mr Bennett for his introductory talk, and to Henry Wiggin and Co. Ltd. and the International Nickel Company for the loan of the film, were proposed by the Chairman.

Alkylation and Polymerization

The 140th general meeting of the Branch was held at the Apex Club on 12 November 1954, when J. L. Deal presented a paper on "Alkylation and Polymerization". The Branch Chairman, Dr A. L. Down, presided.

Mr Deal began by giving a brief review of the historical background of the development of alkylation and polymerization processes. In general, said Mr Deal, the ultimate objective of oil refiners was the preparation of products

attracting the highest realization. Catalytic and thermal cracking achieved this by breaking down heavy oils to motor gasoline, whereas alkylation and polymerization rebuilt into fractions in the gasoline boiling range the gases produced in the cracking processes.

Mr Deal discussed in detail the factors affecting the quality of alkylate and the mechanism of the reactions involved. He then went on to describe two polymerization processes, the production of di*iso*butylene from butane-butene fractions, using sulphuric acid as catalyst, and the manufacture of C_{12} polymer from propylene, using solid phosphoric acid catalyst.

Finally, the speaker reviewed the economics of the processes which depended, *inter alia*, on the realization that the individual refiner could obtain from the cracking gases by other means. These gases might be entirely waste or, as was more likely, might have fuel oil heating value or, at the other end of the scale, gasoline blending value.

J. A. Hulme, refinery manager of Trinidad Leaseholds Ltd., opened the discussion and drew attention to the invaluable contribution of the alkylation process to the Allied war effort, to the very wide use of the process, and its continued importance. He also gave details of early difficulties with the accompanying isomerization process, having been personally associated with the start-up of one of the first two units. A most interesting discussion ensued in which a large number of those present took part, including J. Smith of Universal Oil Products who happened to be visiting the Island.

A vote of thanks for a most interesting and well-presented paper was proposed by J. D. Hall of United British Oilfields of Trinidad Ltd.

Visit to T.N.A. Marine Well

An extremely interesting outing was arranged for Sunday, 12 December 1954, when members of the Branch visited the T.N.A. marine well being drilled in the Gulf of Paria at a point some 14½ miles from Point Fortin and 6 miles from Cedros Point.

The drilling equipment for the well, the first in the proposed Trinidad off-shore drilling programme, is assembled on a platform standing on piles driven 90 feet below the sea bed. The mean depth of water at the location is 40 feet, and the total gross weight on the piles is 952 tons.

The return trip by launch to Point Fortin was enlivened by a heavy rain squall which reduced visibility for a time to a few feet.

The Branch is indebted to the managements of Trinidad Northern Areas Ltd. and The United British Oilfields of Trinidad Ltd. for arranging the visit.

Talk by Professor Morton

At a meeting of the Branch held on 11 January the Chairman, Dr A. L. Down, introduced Professor Morton, a member of Council and Vice-President of the Institute of Petroleum, as a former secretary of the Trinidad Branch (1940-1945) whom the Branch was particularly pleased to welcome.

Professor Morton prefaced his talk by saying how glad he was to be with the Trinidad Branch once more and hoped that the members would take this opportunity to raise any question concerning the activities of the parent body and make suggestions concerning the service which the Institute could render to its overseas members. He then gave an account of the research work at the University of Birmingham on pre-flame reactions in a diesel engine and showed how this investigation was related to the problem of developing the light-weight, high-speed diesel engine. He described the equipment used to obtain samples of combustion products from the engine and to detect the presence of flame in the combustion chamber, and he went on to show how pre-flames occurring in the engine were a function of fuel composition, injection timing, and engine load. He then gave a brief account of other developments in diesel engine research, particularly with regard to problems of ring sticking and exhaust smoke.

The Institute

After concluding his account of diesel engine research, Professor Morton gave a brief account of the various research projects sponsored by the Institute of Petroleum on behalf of industry at various English universities. He also referred to the close co-operation existing between certain of the research projects of the Institute and recent research work sponsored by the API in America. He referred particularly to the recent investigation concerning Los Angeles' "smog" and the contribution to this problem which the API was now making. He also referred to the great help which the petroleum industry was giving to universities in the United Kingdom by providing equipment and scholarships.

The discussion was opened by Dr Malpas, who had himself carried out research on combustion in diesel engines at Birmingham University, and he drew attention to the various photographic techniques employed in these studies. The remainder of this section of the discussion dealt mainly with diesel fuels.

Going on to discuss Institute matters in general, Professor Morton referred to the Benevolent Fund to which members of the Trinidad Branch have made substantial contributions for many years and said how grateful the Council was to members of the Trinidad Branch for their continued support of this particular fund. He gave a very brief account of recent cases which the fund had been used to assist, and hoped that Trinidad would continue their very excellent work in this respect. He conveyed to the members of the Committee the good wishes of the President, the Council, and particularly, the Chairman of the Benevolent Fund Committee.

A vote of thanks to Professor Morton was proposed by A. S. Curlet, a former Chairman of the Branch, which was heartily endorsed by the seventy members and guests present.

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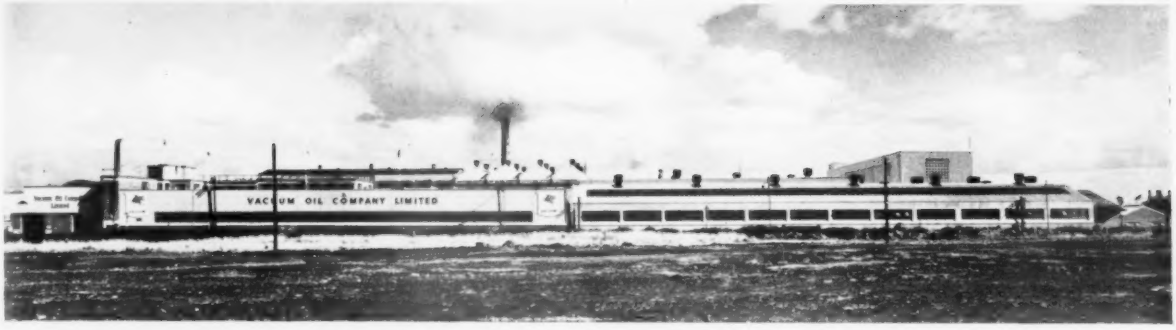
New IP Publications

PETROLEUM IN MODERN TRANSPORT

The full report of the 1954 Summer Meeting of the Institute is now available in a volume entitled "The Role of Petroleum in Modern Transport". This is a cloth-bound, 200-page book containing papers on the use of petroleum products in the transport industry, the properties and requirements of fuels and lubricants used for rail, road, air, and sea transport, and an indication of the future trends in the quality of these products. Prices are £1 5*s*. to members, 30*s*. to non-members, post free.

APPLIED MASS SPECTROMETRY

Papers delivered at the second conference on mass spectrometry held by the Mass Spectrometry Panel of the IP Hydrocarbon Research Group are now available in book form. Twenty-one papers were presented at this conference by leading spectroscopists, and members of an audience drawn from many countries joined in the discussions, which are fully reported in this volume. Price to members of the Institute is £2, to non-members £2 10*s*., post free in both cases.



General view of the Birkenhead works with the new grease plant in the right background.

Vacuum Oil Company's New Grease Plant

Reconstruction at Birkenhead

Vacuum Oil Company's new grease plant at Birkenhead, replacing the one destroyed in 1941 by enemy action, is one of the largest of such works in the United Kingdom or Europe. On the present production pattern of over 200 grades of lubricating grease needed to fulfil the large variety of market requirements, annual output is about 10,000 tons with one shift daily. Space is available for a 50 per cent increase in plant capacity, and a reduction in the number of grades manufactured or an increase in shifts worked would materially affect output.

The Grease Plant

The main buildings housing the grease plant consist of a steel-frame brick-panel construction about 360 feet long and 150 feet wide, with three 50-foot spans; a 3-storey manufacturing and packaging block with two single-storey wings; and a single-storey building for the storage of empty packages and raw stocks. Total area of the plant, including tank farm and oil heater, is nearly 69,000 sq. ft.

Steelwork is of portal-type construction, walls are 16-inch cavity walls, ground floor is a concrete slab with superimposed steelcrete finish, and first and second floors are of concrete reinforced *in situ* with a steelcrete finish. All major building supports are encased in fire resistant concrete and a 6-inch-wide fire ring main has been installed. Artificial lighting is fluorescent and a 6-ton elevator, which can accommodate a loaded fork truck, for goods and staff serves all floors in the manufacturing block.

With the exception of the steel, which was not available in the U.K. market when required, all construction materials were obtained from U.K. supplies.

Work on the new plant commenced in July 1951 and was completed in November 1953, the number of men employed at the peak period being 200. Among the materials used were 300 piles of 35 to 45 feet in depth, half a million bricks, 12 miles of piping from ¼ to 8 inches diameter, 2000 cocks, 82 electric motors, and 400 fluorescent light fittings.

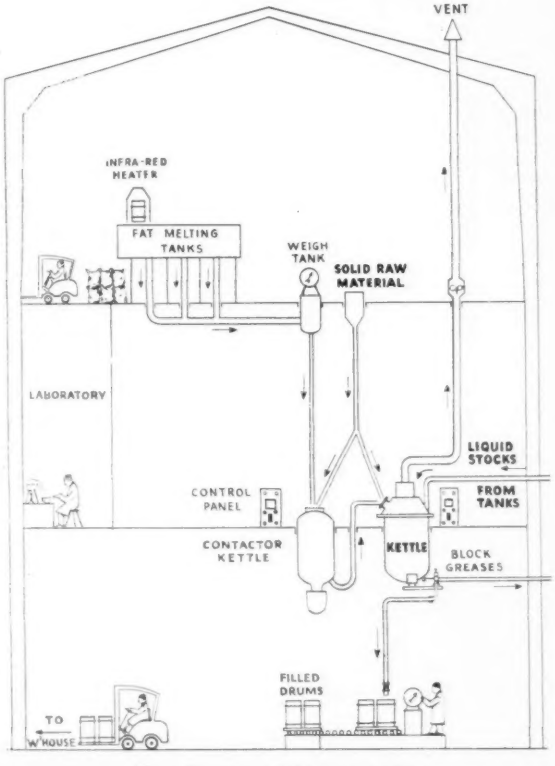
The various items of plant include contactors, kettles, an homogenizer, and an oil heater, while the thirteen storage tanks for raw stocks and oils have a total capacity of 5100 barrels.

The general process of grease manufacture at Birkenhead is outlined below and illustrated in the accompanying diagram.

Raw Materials

The basic solid or semi-solid raw materials used in grease making are fats or fatty acids, and an alkali such as lime or caustic soda. These are first taken to the top floor of the manufacturing building, where they are melted, weighed, and dispensed as required for mixing with the mineral oil constituent.

Materials which need to be melted are first released from their containers by slight heating in a transportable infra-red



Flow diagram of the grease plant.

heater, then liquefied on hot grids, run into weigh tanks, and fed by gravity to the manufacturing vessels on the next floor.

Solid materials are dispensed into portable hoppers standing on weighing machines and gravity fed to the manufacturing vessels. Throughout these operations, care is taken to remove dust.

Manufacture

The chief manufacturing vessels are four Stratco contactor heaters, (three of 6000-lb and one of 3000-lb capacity) and eight kettles (four of 15,000-lb, three of 8000-lb, and one of 2000-lb), these being arranged on the first floor in groups with one contactor to serve two kettles.

The contactors are manufactured by the Stratford Corporation of Kansas City, Missouri, and are of original design. They are oil-heated and each have three heating surfaces, over which the contents are moved at high speed by an impeller driven from the bottom.

Four of the kettles are steam-heated and four are oil-heated, and all are manufactured by W. J. Fraser and Co. Ltd. The contents are mixed by contra-rotating paddles, process time and temperature are controlled by instruments, and the liquid feed from storage tanks is controlled by pre-set meters.

The first floor of the grease plant, showing the controls and piping system of the new automatic grease kettles

Vents to the atmosphere prevent fumes or odours entering the operating room.

Fats and solid constituents from the second floor are fed to the contactor in closely-controlled quantities. There they are heated and mixed under pressure at temperatures up to 450°F, and saponification is completed in about twenty minutes.

When this part of the process is completed, the contents of the contactor are discharged into one of the adjacent kettles. Here the other components and the required amount of mineral oil are stirred into the soap concentrate until the desired result is obtained. The time required for this final stage varies from one to five hours according to product.

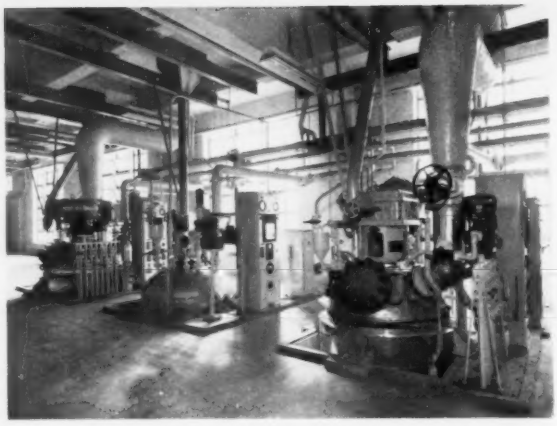
Oil Heater

Contactors and kettles are heated by oil which has been raised to the required temperature in a vertical oil heater designed by Head Wrightson Processes Ltd.

The heating circuit is a closed system taking about 4500 gallons of heat transfer oil and having a capacity of over 10 million B.t.u. per hour. The heater is automatically controlled and fully instrumented, with duplicate instruments on the grease floor to enable operators to determine the temperature and pressure at which the heater is working.

Testing

Before a batch of grease can be considered as completely



Close-up of two of the grease kettles on either side of a contactor heater. On right of kettle is the pre-set oil feed gauge.

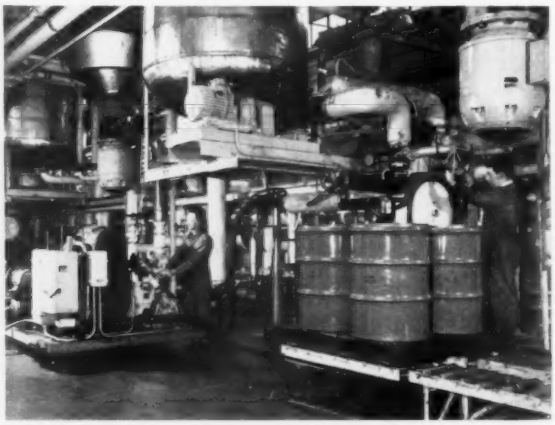
finished it is essential that it be tested to ensure that it conforms to the specified requirements. For this purpose, a well-equipped laboratory is located on the manufacturing floor and here the standard IP tests are performed.

Packaging

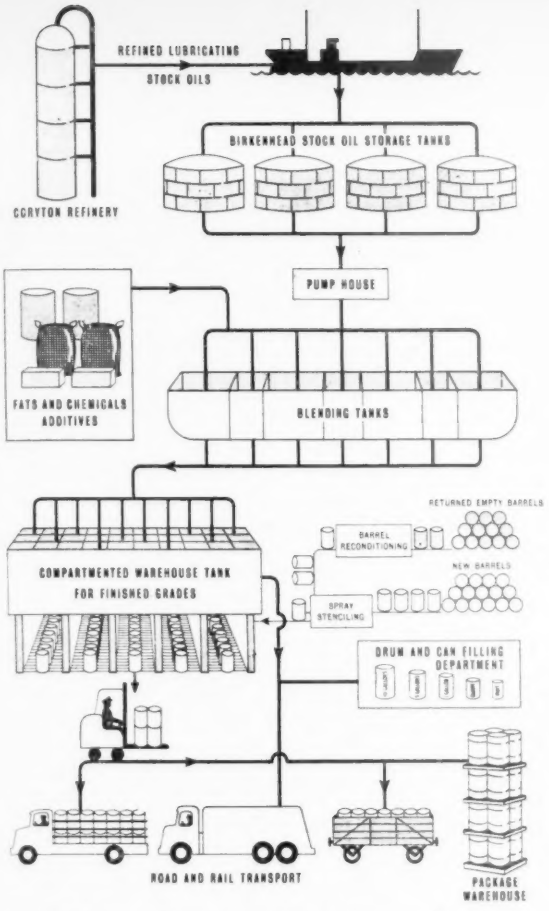
Once approval has been given to a batch, the scene of operations transfers to the ground floor, where are located the bases of the kettles and the outlet valves.

Pre-stencilled packages are brought to the filling point on a fork-lift truck and deposited on the platform of a weighing machine. When the valve is opened the hot finished grease is pumped through filters into the drums until the correct weight is recorded on the dial of the weighing machine. The drums are then removed by fork-lift truck to a cooling area and thereafter sealed and taken to store or to the loading bay.

For some grades of grease it is essential to further mix the ingredients, particularly with the object of ensuring the complete removal of any entrained air. This is attained by pumping the grease through a Cornell homogenizer before filling into its package. In this machine, the grease transverses a rotating disk from centre to edge under vacuum, during which period it is deaerated and homogenized.



Finished grease is filled into steel barrels—seen on the right of this picture. On the left is the homogenizer used to reinforce the mixing in the kettle for some grades of grease. Two kettles, with the contactor heater between them, can be seen in the top left-hand corner.



Flow chart of the oil blending and compounding plant.

Storage and Distribution

Ample space is provided for the storage of finished greases in the single-storey buildings. Movements from plant to store and from store to road or rail loading points are by means of fork-lift trucks. The drums are carried on wooden pallets, which facilitates stacking and unstacking operations.

For the storage of raw stocks and mineral oils, thirteen storage tanks of 150- to 1000-barrels capacity each provide a total capacity of over 5000 barrels.

When block greases are being made the product passes direct from the kettle to the adjoining bay, where the moulding trays are filled. The trays then travel on a conveyor through a cooled tunnel, where solidification occurs, and the blocks are subsequently cut to meet customers' requirements.

Research

Although the basic research work is done in New York by the Socony-Vacuum Oil Co., a considerable amount of laboratory scale development work on greases is carried out in the central laboratories of the Vacuum Oil Co. Ltd. at Wandsworth, London.

The next stage is to make pilot plant experiments and for this purpose a pilot plant is available at Birkenhead. This plant consists of a 100-lb contactor and a 400-lb kettle.

General

Essential services such as steam, air, water, etc., are all controlled by a central console (New Weston Ltd.) on the first floor of the manufacturing block, the instruments being supplied by the Bristol Instrument Co. Ltd.

Transfer and filling-off pumps, steam-jacketed where necessary, are by Stothert and Pitt Ltd. and of the rotary positive-displacement type. Centrifugal, water-cooled hot oil circulating pumps by Hayward, Tyler and Co. Ltd. are used in conjunction with the oil heater.

Main contractor for the grease plant was Head Wrightson Processes Ltd.; building design was by Sir Percy Thomas and Son; and civil contractors were Sir Alfred McAlpine and Son Ltd., and A. Monk and Co. Ltd.

Numerous sub-contractors were engaged in the construction of the plant.

Total cost of the completed plant was about £850,000.

Oil Blending and Compounding

In addition to the grease plant described above, the Birkenhead works of the Vacuum Oil Company also includes an up-to-date oil blending and compounding plant for the manufacture of many grades of lubricating oils for all types of machinery.

As the works are located on the quayside at West Float, Birkenhead Docks, refined stocks can be brought in from Coryton refinery by coastal tanker and discharged direct to storage.

The design and layout of the plant follows normal convention, but a feature worthy of note is the large compartmental tank on top of the packaging bay which is used for the storage of finished grades. This tank, which has a total capacity of 12,000 barrels, is divided into 99 separate compartments varying in capacity from 60 to 360 barrels each.

Capacity of this plant is such that during 1954 an average of 1500 to 2000 tons per week of finished lubricating oils were dispatched by road, rail, or by sea.

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Trade Literature, etc.

New Protective Paints

Two new paints are now being manufactured by Allweather Paints Ltd., makers of chlorinated rubber paints.

Pitan cold temperature resistant paint has been specially produced to withstand temperatures as low as -60° F without losing its flexibility. It offers protection against acid and alkali attack and against the effects of brine and ammonia.

A second product that has been newly developed is a chlorinated rubber based paint which is resistant to mould. This contains mercury which has good fungicidal properties.

Electrodes

A pocket guide to electrodes has been published by Metropolitan-Vickers Electrical Co. Ltd. of Trafford Park, Manchester.

Details are given of the Company's range of electrodes and there are also some useful conversion tables.

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CRUDE OIL PRODUCTION

	1954	
	December	*Jan. to Dec.*
	Tons	
Iraq Petroleum Co. Ltd. .	2,057,674	23,731,108
Basrah Petroleum Co. Ltd. .	443,456	4,592,196
Mosul Petroleum Co. Ltd. .	107,602	1,283,443
Qatar Petroleum Co. Ltd. .	429,543	4,704,423
	Brl	
Kern Oil Co. Ltd.:		
California	103,273	—
Trinidad	82,675	—

Personal Notes

T. Bourhill has retired from his position as manager, Marketing Secretariat, Esso Petroleum Co. Ltd. Mr Bourhill joined the Company in 1911 as an office junior, and after the first world war held a number of positions with the Company.

In 1939 Mr Bourhill was appointed a director of Standard American Oil Company S.A. in Belgium, but he was forced to leave that country during the war and returned to England as acting secretary of the Anglo-American Oil Company. In 1945 he was appointed manager, Costs and Operations Department, and in 1948, manager, Marketing Secretariat.

V. C. Georgescu has been appointed an assistant co-ordinator of the producing activities of Standard Oil Co., New Jersey. Mr Georgescu joined Standard Oil in New York in 1947 after serving for several years with Romano-Americana, a Jersey Standard affiliate in Rumania of which he was President and Chairman of the Board.

Standard Oil Co. has also announced the appointment of **H. E. Winter** as regional executive for South American production. Mr Winter, who first joined Lago Oil and Transport Co. Ltd., another Jersey Standard affiliate, in 1935, has been employed on the "producing co-ordination" staff of Jersey Standard since August 1954.

S. Schackne has been appointed manager of the Public Relations Department of the Standard Oil Company (New Jersey). Mr Schackne has been an assistant manager of the department since 1945 and succeeds G. H. Freyermuth who was recently elected executive vice-president and a director of Esso Export Corporation.

B. M. C. Trench, M.A., has succeeded T. S. Powell as manager of the Public Relations Department of the Shell Petroleum Co. Ltd. following Mr Powell's retirement on 31 January.

Mr Trench joined Shell as a legal adviser in October 1945 after practising as a solicitor from 1933 to the outbreak of war. During his employment with Shell he served in the Legal Department until June 1952, when he was given a special assignment, and during that same year he took a business administration course at Harvard University, U.S.A.

Three members of the Birmingham Students Branch of the Institute were awarded the degree of Doctor of Philosophy at a ceremony at Birmingham University in December last year. They are **E. J. Charles, A. Sagarra,** and **R. B. Shearn,** all members of the University's School of Chemical Engineering.

L. M. Broadway has been appointed chairman of the Board of John B. Pillin Ltd., a member of the Wakefield group of companies, in succession to Alonzo Limb who has resigned owing to ill-health.

C. E. R. Millidge and **J. J. Brookman** have been appointed directors of the Company.

K. G. Mackenzie has been awarded a certificate of appreciation by the American Society of Automotive Engineers for his outstanding contribution to the work of its Fuels and Lubricants Technical Committee.

Mr Mackenzie has been a member of the Committee and its predecessor, the Lubricants Division, since 1923. Since 1933 he has represented the ASTM, of which he is a past president and honorary member. Mr Mackenzie is now engaged in consulting work, having retired from The Texas Company which he served for 43 years.

Dr P. E. Kent, a senior geologist of The British Petroleum Co. Ltd., has been awarded the Bigsby Medal by the Council of the Geological Society "for contributions to the palaeo-geography and stratigraphy of England and Wales, and his researches in Central Africa and Persia".

Dr Kent joined British Petroleum in 1936. He has been closely associated with the Company's drilling programme in the United Kingdom and has also worked in Persia and East Africa, where a test well is being drilled on Mafia Island, off the coast of Tanganyika.

R. A. Hyslop has retired from his position as assistant general sales manager with the Esso Petroleum Co. Ltd. after 44 years' service with the Company. Mr Hyslop joined the Company as a junior clerk in 1910. After a break during the war years he returned to take up a series of appointments leading to the position of manager of the East London

Long-service Presentations

A presentation luncheon was held recently at the Lobitos Refinery, Ellesmere Port, at which presentations were made to 47 employees who had completed 20 years' continuous service with Lobitos Oilfields Ltd.

The presentations were made by the chairman of the Company, F. C. Bowring, assisted by the general manager, J. E. Hall.

Employees had been given the choice of a watch, a clock, a canteen of cutlery or a cigarette case.

Inset photograph shows J. S. Parker, refinery manager and a member of the Council of the Institute, receiving his presentation from Mr Bowring. (Photo is by Wm. Cull.)

Branch in 1928 and manager of the East London sales division in 1934. In 1937 he was appointed assistant general sales manager at the head office of the Company.

During the second world war Mr Hyslop acted for a while as technical adviser to the London Regional Petroleum Office. After the war he played an important part in reorganizing the Company's General Sales Department.

Changes in Esso General Sales Department

Esso Petroleum Co. Ltd. has announced that, with effect from 1 January 1955, its General Sales Department has been reorganized as follows:—

In place of three assistant general sales managers there are now two regional managers and a costs and operations manager. Also, a new Division has been established within the Department, to be known as "National Trade Division", which comprises the Aviation Department and National Accounts Department.

Consequent upon this reorganization, the following appointments have been announced:—

A. W. Wooldridge, M.Inst.Pet., assistant general sales manager, is now regional manager (South).

E. F. Choppen, M.Inst.Pet., assistant general sales manager, is now costs and operations manager.

E. W. Hardiman, M.Inst.Pet., manager, South-Western Division, has become regional manager (North) in succession to **R. A. Hyslop,** assistant general sales manager, who has retired from his position with the Company.

R. D. Streeton, A.M.Inst.Pet., manager, Wholesale Department, becomes manager, South-Western Division, in place of Mr Hardiman.

T. C. G. Thorpe, F.Inst.Pet., deputy manager, becomes manager, Wholesale Department, in succession to Mr Streeton.

H. W. Wright, deputy manager, becomes manager, Marketing Secretariat, in succession to **T. Bourhill** who has retired after 43 years' service.

H. A. D. Airey, divisional sales manager, Northern Division, becomes manager of the newly-constituted National Trade Division.

D. D. Campbell, A.M.Inst.Pet., costs and operations manager, Northern Division, succeeds Mr Airey as division sales manager.

J. Sutherland, district manager (Landor Street, Birmingham), becomes costs and operations manager, Northern Division.

M. L. McLaughlin, A.F.Inst.Pet., succeeds Mr Sutherland as district manager (Landor Street, Birmingham).

W. F. Billingham, M.Inst.Pet., district manager, Plymouth, becomes credit manager, South-Western Division.

B. Croft-Baker succeeds Mr Billingham as district manager, Plymouth.

R. G. Protheroe, A.M.Inst.Pet., deputy manager, becomes manager, Purfleet Terminal, in place of **P. Low,** M.Inst.Pet., who is retiring after 35 years' service with the Company. Mr Low first joined the Company in 1920 when he was appointed Branch engineer and assistant installation manager in Belfast. He became manager of the Purfleet Terminal in 1933.

Mr Protheroe first joined the Company in 1938. After five years at the Ellesmere Port Terminal he was transferred to Purfleet as Terminal Assistant and later became deputy terminal manager.

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The British Petroleum Co. Ltd.

Its Origins and Development

The taking of a new name, The British Petroleum Co. Ltd., by one of the world's largest oil groups has drawn attention to the origins and development of its activities.

It is now almost fifty years since the Anglo-Persian Oil Company was formed, in 1909, to exploit the oil resources of Persia.

Before that date drilling activities had already begun in Persia. In 1901 William Knox D'Arcy, a Devon-born man who had made a fortune in gold in Australia, was granted an oil concession by the Persian Government. Drilling began in 1902 but years of fruitless exploration followed and Burmah Oil Company eventually took over operations from D'Arcy. It was not until 1908, when resources had almost been exhausted, that oil was struck at Maidan-i-Naftun.

Following this discovery, the Anglo-Persian Oil Company was formed and took over all the rights and obligations of the D'Arcy concession. A site was chosen for the Abadan refinery and by 1913 the refinery was in full production.

Marketing problems followed but the months before the first world war brought valuable developments: a long-term contract was obtained to supply fuel oil for the British Navy, and the British Government invested £2,000,000 in the Company.

Expansion to meet these new commitments was hindered by the first world war, but by 1917 the Company was able to expand both at the oilfields and at Abadan, and a start was made in the building of the Company's tanker fleet. It was at this time that the Anglo-Persian Oil Company took over the small marketing organization, known as The British Petroleum Company, from which it derives its present name.

The end of hostilities was followed by further expansion, including the building of Llandarcy refinery and the extension of the Company's marketing system to Europe and Australia.

In 1933 the D'Arcy concession was revised, the area being reduced to 100,000 square miles and the term extended to 1993. In 1935 the name of the Company was changed to the Anglo-Iranian Oil Company, in line with the renaming of Persia as Iran.

The second world war caused first of all curtailment and later, vast expansion, of the Company's activities. Abadan replaced the Japanese-held resources of the Dutch East Indies and Burma and by 1950 had a throughput of 25 million tons a year.

The oil dispute of recent times, its solution, and the formation of a consortium in which British Petroleum has a 40 per cent interest, bring the history of the Company up to date.

Today the activities of The British Petroleum Company are varied and widespread. The Company's refinery interests have grown since the end of the second world war and are firmly established not only in the United Kingdom and Europe but also throughout the world, in Aden, Kwinana, and, with the Shell Group, in Haifa.

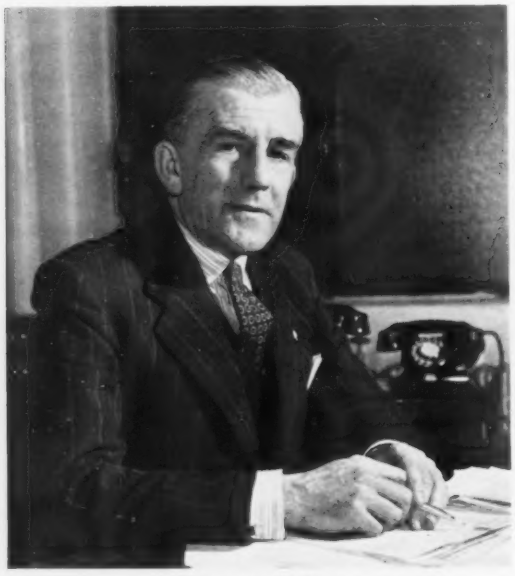
B.P.'s shipping subsidiary, the British Tanker Company, has a fleet of 149 ships. Separate companies market the Company's products in many parts of the world and in others the Company's products are marketed in conjunction with other Groups. A world-wide ships' bunkering organization and an expanding aviation service are further aspects of the Company's present activities.

Oil as a Source of World Energy—

A Refiner's View

In a speech delivered to the Fuel Luncheon Club in London on 18 January Mr E. Le Q. Herbert, general manager of The "Shell" Refining and Marketing Co. Ltd., spoke of the world-wide interests of the petroleum refining industry and of the role of oil as a source of world energy.

Mr Herbert began by saying that this was the story of a half-century of change and development which was probably unparalleled in any other sphere of industry. During the last 30 years or so, world energy requirements had increased by



E. Le Q. Herbert

rather less than 2½ times, but within this total the effective contribution of oil and its associated fuel—natural gas—had increased from about one-sixth to around one-half. Even in the U.K.— the example *par excellence* of a coal economy—oil now contributed well over 10 per cent of total energy needs as compared with less than 4 per cent in the early 1920s. Elsewhere in Western Europe the picture was substantially the same.

Accepting, therefore, the conclusion that the energy requirements of the world were increasing at this great pace—and would continue to do so—it was equally clear that in the next decade or two oil must play the leading part in meeting these additional demands.

Mr Herbert gave two reasons for this deduction: firstly, oil fuels were fluids—motion was almost an inherent property of them—and their transport to the consumer was relatively easy. Secondly, (a much more compelling consideration) the art of the refiner was now so far advanced that he was to a very great extent independent of the initial—the original—quality of the crude oil he processed in so far as concerned the quality (and to a somewhat lesser but nevertheless significant extent) the quantity of the fuels he wished to produce. The properties —the quality—of the different fuels—petroleum gas, gasolines, jet fuels, power kerosines, diesel fuels, bunker fuels, and so on, and the relative quantities in which they could be produced, were becoming more and more dependent on refining processes and less and less dictated by the character of the crude oil from which they were derived.

This flexibility of operation and production—combined with the world's ever-increasing demand for more power—led, the speaker said, to increasing quantities and ever-increasing quality of its fuels. The petroleum industry (whether it liked it or not) was in fact in a spiral of expansion. The inventor, moreover, had learned that seldom if ever need he design for the fuel. That would be "tailor-made" for him by the petroleum industry.

Mr Herbert referred to the quite remarkable development of the high-speed diesel engine for all forms of traction and small-size generators. These engines needed special oil fuel, but development had never been held up for want of a suitable fuel. Again, in the medium-speed diesel engine range, there had been a most remarkable change-over from steam to oil in the U.S.A. for long-distance rail haulage.

In addition, the comparatively recent invention and development of the jet engine could scarcely have taken place, said Mr Herbert, if the special type of oil fuel required had not been developed and made available at the same time.

No other fuel in common use, said Mr Herbert, could give such a picture as that. If the industrial economy of the world depended on prime-movers making more efficient use of fuel these must be invented and oil was the fuel that went hand-in-hand with the inventor and with new ideas.

Admitting that this was the refiner's view and by no means an impartial one, Mr Herbert submitted that the history of the U.K. and of Europe in the last few years confirmed it. In 1947 Western Europe had some 15 million tons of refining capacity; the figure for 1954 was over 100 million tons. In 1947 the U.K. had some 2½ million tons; now it was around 30 million tons—a twelve-fold increase in seven years—and the capital expenditure involved in this expansion was around £200 million.

Europe's largest refinery in both intake capacity and in the integration and complexity of its petroleum and petrochemical operations was at Pernis near Rotterdam in Holland —with an annual capacity of over 10 million tons; this meant the output of more than 2500 million gallons of petroleum and petroleum chemical products every year. Other large refineries—many of them with associated petroleum chemical plants—were situated in France, Italy, and the United Kingdom.

Mr Herbert expressed his certainty that the present increase in the world demand for energy was inherently bound up with this development of petroleum fuels,—indeed it was a direct consequence of the discovery and exploitation of the world's oil reserves. Petroleum fuel in its almost infinite variety—from gas to asphalt—was the major fuel of the present and, in his opinion, of the immediate future as well.

Other Forms of Energy

Turning to the competitors of petroleum, Mr Herbert spoke first of water power, and said that the harnessing of water for the production of electricity on a large scale was a relatively new development and even today produced only some 6 to 8 per cent of world energy needs. Although many projects were in hand, there were, he suggested, physical as well as financial handicaps to the wide-spread use of that form of power.

Then there was natural gas. That was, of course, a most important source of energy in the United States and to a lesser extent in Italy, and its use was increasing rapidly. In the U.K. finds of natural gas had so far been small and the opinion had been expressed that whilst there were reasonable prospects of finding enough gas to justify the expenditure on an extensive search, the ultimate production was likely to be strictly limited.

The most prolific source of natural gas outside the Western Hemisphere was, said Mr Herbert, in the oilfields of the Middle East and various ways of moving this gas to the industrialized areas of Western Europe had recently been discussed; for instance, a pipeline from the Persian Gulf to continental Western Europe, or the carriage by sea of refrigerated gas in specially constructed tankers with balsa-wood lined tanks; but it was too early as yet to say whether these schemes would ever become commercially economic propositions, especially in view of the political and technical problems involved.

Of atomic energy, Mr Herbert said that in this sphere also it was too early to predict the likely trend of events with any degree of certainty. The estimates of the top experts were certainly contradictory. All that could safely be said at the moment was that atomic power was likely to be of only marginal significance over the next 20 to 25 years. It was certainly vitally important, though, that atomic energy plans should be pressed forward.

In respect of the future of coal and oil supplies, one could fortunately be a good deal more definite. These were in fact the two sources of energy which together were likely to provide the lion's share of world energy requirements in the next quarter of a century.

As far as coal supplies were concerned, the prospects did not seem to be bright and the recent statement made by the Minister of Fuel and Power in the U.K. suggested that the oil industry here and elsewhere would be required to provide most of the additional energy needs associated with world economic progress. It was not unreasonable to assume that the next 25 years would produce a demand for oil of at least double the current level and the U.K. and Western Europe were not likely exceptions to that general trend.

Whilst it was true to say that the immediate postwar programme of refinery construction in the U.K. and in Europe was virtually completed some time ago, that did not in any way imply that expansion had ceased; indeed just the reverse was true. New refineries were still being built and existing ones were constantly being expanded and modified. No refinery was ever "complete"—ever finished; because in no other industry did process and plant development follow research so closely or so quickly.

This new industry in Western Europe had brought many complex problems to the refiner. Not least of these was the gradual trend of demand towards black oils—the heavy fuel oils. In spite of all the flexibility of operation so far achieved by the refiner, there must be a limit to that trend at some stage; the economics of refining would dictate a halt to it—a halt which would be brought about not only by the limits of the black oil content of a barrel of crude oil but also by market price factors. If more fuel were to be produced, every encouragement must be given to maintaining an economically balanced output of products and, therefore, to every reasonable means of expanding the demands for the white oils. This brought to the fore the importance of reconsidering present petroleum taxation policies with their repressive effects on the consumption of light products.

In short, the oil industry's—the refiner's—view was that if the oil industry were to meet the demands made upon it, the whole structure of fuel prices—be it coal or oil—must reflect their true economic worth. Furthermore, the enormous capital expenditure involved to provide for the continuous expansion of the refining and distribution sections of the industry necessitated a taxation policy which would enable it to continue to generate—as it always had done in the past—the major part of its own vast capital requirements.

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Council Commentary

At a Council meeting held on 12 January, a number of items of immediate interest to all members were discussed. For example, it has been decided to reissue the list of members. This will provide additional information of the member's "trade", and forms asking for the necessary information will be issued shortly. It is very gratifying to know that one of the reasons for the reissue of the membership list is the steady increase in the number of members of the Institute.

It was also reported that Part II of the I.P. Safety Code has now been issued and together with Part I constitutes a document of very considerable usefulness to refinery, shipping, and depot managers. It was also learned that the Refining Code was well in hand.

In June of this year, the International Standards Organization (I.S.O.) will hold its second meeting in London, the first having been held about four years ago in New York. At this meeting it is hoped that agreement will be reached on the international standardization of some of the most widely used petroleum test methods. The British Standards Institution is the officially recognized standardizing body for the United Kingdom and the Institute is in close touch with B.S.I. in order to formulate an agreed programme of proposals.

Mr E. Le Q. Herbert had appreciable progress to report regarding the activities of the international convention dealing with the oil pollution of the sea. He explained that sub-committees had been formed, each of which covered specific features of the whole problem. For example, one of these sub-committees would deal with the design of oily water separators, another with the provision of adequate port oil separation facilities, and a third would handle experiments to determine the persistence of oil films on water.

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PRIZES FOR NAVAL ARCHITECTURE

The Institution of Naval Architects makes an annual award of the Samuel Baxter Prize (or prizes) for the best contribution during the year towards safety and/or efficiency in sea-going vessels.

The work submitted must take the form of a paper, essay, description, or drawing of any new design, invention, process, equipment, or apparatus relating to safety and/or efficiency in sea-going vessels.

Claims will be considered from any persons who wish to submit their work or who have work submitted on their behalf.

Submissions must be received by the secretary of the Institution of Naval Architects by 31 December 1955.

Books and Films

"The Story of Coryton"

From Essex marshland to impressive refinery is the achievement described in the Vacuum Oil Company's latest film—"The Story of Coryton". This is a non-technical documentary film which shows the construction of the refinery from the first pile-driving activity necessary to strengthen the Essex marshland, through the work of plant erection, to the official opening of the refinery by Her Majesty Queen Elizabeth the Queen Mother on 27 May 1954.

The ravaging floods of the spring of 1953, which brought near destruction to the half-finished refinery, add drama to the film.

"The Story of Coryton" is a 16-mm film and runs for approximately 30 mins. Copies are available on request from The Film Library, Sound Services Ltd., 269 Kingston Road, Merton Park, London, S.W. 19.

Safe Use of Industrial Trucks

Mechanical handling equipment has overcome many of the bad features of manual lifting practice and brought increased efficiency to industry: at the same time, it has introduced fresh safety problems which demand for their solution the safety-consciousness of equipment manufacturers and the exercise of intelligence and care by operators.

The increasing use of industrial power trucks has led the Industrial Truck Manufacturers' Association to formulate codes of practice—the first of which has recently been issued. The "Safety Code for Industrial Power Trucks" opens with an itemized survey of the safety features which should be incorporated in driver-operated and pedestrian-controlled types of fixed and elevating platform trucks, industrial towing tractors, fork trucks, straddle carriers, and special powered load carriers, excepting cranes and motor vehicles as such.

Other sections deal with the computation of safe-working loads and the safe operation and maintenance of the equipment.

A section is devoted to the safe use of straddle carriers and, finally, there is a humorously-illustrated code of operators' safety rules and regulations.

Copies of the Code are obtainable from the Industrial Truck Manufacturers' Association, 94-98 Petty France, London, S.W. 1. Price 2s. 6d., post free.

Achema Jahrbuch 1953 1955

This volume of some 900 pages, printed in English, French, and German, is a valuable guide to the European chemical apparatus and equipment industry. The opening general section includes articles on Achema and reports from European universities on their work in this field. Then follows a series of articles dealing with technical developments, with emphasis on products to be exhibited at this year's Achema exhibition.

The next 108 pages are devoted to a list of names and addresses of 819 firms from 13 countries, followed by a classified list of some 6000 varieties of apparatus, etc., and their manufacturers. A trilingual list of trade names concludes the text material. The book is published by H. Bretschneider, Dechema Deutsche Gesellschaft für chemisches Apparatewesen, Frankfurt am Main.

Standard Sizes for Manufacturers' Literature

A British Standard has recently been issued which deals with the sizes of manufacturers' trade and technical literature and includes recommendations for the contents of catalogues.

The Standard has been drawn up to encourage uniformity in working instruction sheets which may be collected in one binder by a main contractor, and also to ease the task of librarians in retaining catalogues, brochures, etc.

Copies of the Standard, B.S. 1311: 1955, are obtainable from the British Standards Institution, 2 Park Street, London, W. 1. Price 2*s.* 6*d.*, post free.

Motor Cycle Lubrication

An up-to-date version has recently been published of "Motor Cycle Lubrication"—a useful booklet dealing with lubrication problems from the layman's point of view.

The booklet has been completely rewritten and redesigned. A preliminary note deals with the history of lubrication. Descriptions of the various lubrication systems follow, and there are separate sections dealing with forced feed lubrication and the lubrication requirements of the transmission system. The last section deals with auxiliary and electrical fittings.

Copies are obtainable free on request from C. C. Wakefield and Co. Ltd., 46 Grosvenor Street, London, W.1.

Lubrication Booklets

A revised edition has recently been issued of "Road Vehicle Lubrication", a comprehensive, illustrated booklet published by the Wakefield-Dick Industrial Lubricants Division of C. C. Wakefield and Co. Ltd.

Other books in the Wakefield-Dick Technical Series deal with: turbine lubrication, machine tool lubrication, oil engine lubrication, cutting oils, rock drill lubrication, colliery lubrication, laundry machinery lubrication, steel works lubrication, transformer and switch oils, earth-moving machinery lubrication, and gear lubrication.

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MINING AND METALLURGICAL CONGRESS

The Sixth Empire Mining and Metallurgical Congress is to be held in Canada during 1957 at the invitation of the Canadian Institute of Mining and Metallurgy.

In making this announcement, The Empire Council of Mining and Metallurgical Institutions, of which the Institute is a constituent body, states that full particulars will be circulated within the next few months to members of the principal mining and metallurgical societies in the Commonwealth. Meanwhile, some particulars are available from the Honorary Secretary, Empire Council of Mining and Metallurgical Institutions, 436 Salisbury House, Finsbury Circus, London, E.C.2.

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INSTRUMENT INDUSTRIES' EXHIBITION

The third British Instrument Industries' Exhibition is to be held at Earls Court, London, from 28 June to 9 July 1955.

The exhibition, which is being organized by F. W. Bridges and Sons Ltd., is sponsored by the following bodies: The British Electrical and Allied Manufacturers' Association; The British Industrial Measuring and Control Apparatus Manufacturers' Association; The British Lampblown Scientific Glassware Manufacturers' Association; The Drawing Office Material Manufacturers' and Dealers' Association, and The Scientific Instrument Manufacturers' Association of Great Britain.

Latest developments in scientific and electrical instruments, industrial meters, etc., will be shown at the exhibition.

U.K. Petroleum Trade in 1954

By GEORGE SELL (*Fellow*)

Total U.K. imports of crude petroleum and liquid refined products in 1954 were 9040 million gallons, an increase of 3.3 per cent or nearly 290 million gallons over the figure for 1953. The corresponding c.i.f. value at £307,693,524 was practically the same as for 1953.

In 1954 the order and grouping of the entries in the statistics compiled by H.M. Customs and Excise were revised to agree with the Standard International Trade Classification (SITC) of the United Nations. Under Class C, Mineral Fuels and Lubricants (SITC Section 3), Division 2 relates to Crude petroleum (312) and Refined petroleum (313). As far as possible the figures for the years prior to 1954 have been adjusted in the official return* to be comparable.

From Table I it will be noted that there was a considerable drop in the total import of refined liquid products, which was 2084 million gallons in 1953 and 1844 million gallons in 1954. However, this was more than compensated for by the increase of about 530 million gallons in the crude oil total.

In Table II the imports are expressed as percentages of the total.

Average c.i.f. values on a unit basis have been calculated in Table III and for the year 1954 were generally lower than in 1953.

The country of consignment of U.K. imports is no

TABLE I

QUANTITY AND VALUE OF U.K. PETROLEUM IMPORTS

	1954		1953		1952	
	Quantity 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £
Crude petroleum (312):						
Processed	317,315	11,784,765	219,347	7,289,546	236,982	8,764,958
Other	6,878,865	208,678,949	6,447,050	210,677,270	5,688,995	228,402,852
	7,196,180	220,463,714	6,666,397	217,966,816	5,925,977	237,167,810
Refined petroleum (313):						
Motor spirit	426,697	25,425,313	497,461	32,313,684	507,964	32,319,151
Other spirit	46,137	2,844,102	82,380	4,762,655	50,173	3,165,090
Kerosine	360,064	16,926,996	384,478	19,215,347	403,030	21,914,586
Gas oil:						
Refinery feed	71,548	3,651,296	27,296	2,670,652	2,979	1,138,927
Other	372,968	16,767,017	272,774	12,543,994	207,464	10,446,495
	444,516	20,418,313	300,070	15,214,646	210,443	11,585,422
Diesel oil	52,958	2,040,544	57,740	2,363,409	77,050	3,659,670
Fuel oil	385,697	10,647,742	227,379	6,367,466	258,730	9,354,685
Lubricating oil	114,374	8,757,441	111,143	9,198,678	109,186	13,330,676
Other refined petroleum and lubricating compounds	—	163,559	—	144,000	—	144,384
Refined oils, inedible, not elsewhere specified	13,591	5,800	423,323	176,943	591,383	305 867
Total liquids	9,040,214	307,693,524	8,750,371	307,723,644	8,133,936	332,947,341
	Cwt		*Cwt*		*Cwt*	
Mineral jelly	155,499	472,320	183,494	499,910	124,961	384,121
Waxes:						
Paraffin wax	805,041	2,867,090	285,038	897,764	456,766	1,551,399
Other petroleum wax	154,618	663,231	90,003	415,873	60,999	298,791
Montan and ozokerite or earth wax	7,449	44,390	3,795	29,221	4,783	67,144
Pitch (excluding natural asphalt and bitumen), petroleum coke, and bituminous asphalts (manufactured) and emulsions other than for use as paints	*Tons* 20,320	477,197	*Tons* 19,130	418,218	*Tons* 15,323	290,516
Total of Class C, Division 2	—	£312,217,752	—	£309,984,630	—	£335,539,312

TABLE II

PERCENTAGE IMPORTS OF PETROLEUM INTO THE U K.

	1954	1953	1952
		Per cent	
Crude petroleum	79.6	76.2	72.8
Motor spirit	4.7	5.7	6 2
Other spirit	0 5	0.9	0 6
Kerosine	4.0	4.4	5 0
Gas oil	4.9	3.4	2.6
Diesel oil	0.6	0.7	0 9
Fuel oil	4.3	2 6	3.2
Lubricating oil	1.3	1.3	1.4
Refined oil, n.e.s.	0.1	4.8	7.3
	100.0	100.0	100.0

* "Accounts Relating to Trade and Navigation of the United Kingdom, December 1954". London: HMSO, 12*s.* 6*d.*

TABLE III

AVERAGE C.I.F. UNIT VALUES OF U.K. PETROLEUM IMPORTS

	1954	1953	1952
		£ *per* 1000 *gal*	
Crude petroleum	30.64	32.70	40.02
Motor spirit	59.58	64.96	63.62
Other spirit	61.64	57.81	63.08
Kerosine	47.01	49.98	54.37
Gas oil	45.93	50.71	55.05
Diesel oil	38.53	40.93	47.50
Fuel oil	27.61	28.00	36.12
Lubricating oil	76.57	82.76	122.18
Other refined oils	0.43	0.42	0.52
		£ *per cwt*	
Mineral jelly	3.04	2.72	3.07
Paraffin wax	3.56	3.15	3.40
Other petroleum wax	4.29	4.62	4.88
Montan and earth wax	5.96	7.70	14.04

necessarily the country of origin or manufacture. The information available to consigning countries is extracted in Table IV, the principal change from 1953 being that Venezuela has risen from seventh to fourth in order of magnitude. As in 1953, Kuwait supplied slightly more than half of the total import of all liquids and over 63 per cent of the total crude petroleum import.

In Table V the import quantities have been allocated on a regional basis, and the importance of the Middle East as the major source of U.K. petroleum requirements is clearly

TABLE IV

COUNTRIES CONSIGNING PETROLEUM TO THE U.K.

Country and Product	1954	1953	1952
		Thousand gallons	
KUWAIT:			
Crude petroleum	4,568,637	4,042,011	3,362,717
IRAQ:			
Crude petroleum	1,338,676	1,672,252	1,044,130
NETHERLANDS ANTILLES:			
Crude petroleum	300,000	186,880	197,676
Motor spirit	76,583	101,173	147,854
Kerosine	195,630	205,106	210,907
Gas, diesel, and fuel oils	214,207	117,405	104,411
Lubricating oil	14,429	19,385	14,114
	800,849	629,949	674,962
VENEZUELA:			
Crude petroleum	352,035	217,784	149,418
Motor spirit	—	464	16,074
Kerosine	17,253	16,623	18,171
Gas, diesel, and fuel oils	118,437	45,895	23,575
	487,725	280,766	207,238
BAHREIN, QATAR, AND TRUCIAL OMAN:			
Crude petroleum	376,469	412,391	210,933
Motor spirit	50,959	41,773	28,347
Kerosine	8,460	11,458	5,707
Gas, diesel, and fuel oils	25,969	17,100	10,419
	461,857	482,722	255,406
UNITED STATES OF AMERICA:			
Crude petroleum	37,016	30,061	22,016
Motor spirit	52,516	88,048	121,560
Kerosine	9,293	14,045	44,176
Gas, diesel, and fuel oils	180,819	196,058	176,101
Lubricating oil	77,901	74,869	89,346
	357,545	403,081	453,199
TRINIDAD:			
Motor spirit	125,835	121,437	50,929
Kerosine	78,568	99,614	114,627
Gas, diesel, and fuel oils	129,208	124,836	44,985
	333,611	345,887	210,541
NETHERLANDS:			
Crude oil	10,043	7,942	5,936
Motor spirit	94,599	114,428	64,440
Kerosine	39,254	30,233	7,148
Gas, diesel, and fuel oils	115,184	41,705	64,712
Lubricating oil	4,652	4,511	3,769
	263,732	198,819	146,005
FRANCE:			
Motor spirit	9,922	8,281	36,051
Gas, diesel, and fuel oils	34,406	24,196	61,231
	44,328	32,477	97,282
SAUDI ARABIA:			
Crude petroleum	40,543	58,508	880,998
PERU:			
Crude petroleum	35,736	30,176	35,204
BELGIUM:			
Motor spirit	2,002	15,456	37,861
Gas, diesel, and fuel oils	1,778	15,111	52,000
	3,780	30,567	89,861
WESTERN GERMANY:			
Motor spirit	1,508	4,860	4,826
OTHER COMMONWEALTH COUNTRIES AND IRISH REPUBLIC:			
Crude petroleum	110,115	6,135	—
Motor spirit	3,663	272	21
Kerosine	157	189	199
Gas, diesel, and fuel oils	3,096	1,308	2,997
Lubricating oils	55	142	173
	117,126	8,046	3,390
OTHER FOREIGN COUNTRIES:			
Crude petroleum	26,870	2,257	16,949
Motor spirit	9,110	1,269	1
Other spirit	46,137*	82,380*	50,173*
Kerosine	11,449	7,210	2,095
Gas, diesel, and fuel oils	60,067	1,575	5,792
Lubricating oils	17,337	12,236	1,784
Refined oils, n.e.s.	13,591*	423,323*	591,383*
	184,561	530,250	668,177

* Includes also some quantities from "Other Commonwealth Countries".

indicated. It is noted also that there was an increase of about 29 per cent in the quantity imported from the Caribbean and Peru.

Comparatively small quantities of imported petroleum products are re-exported and the relative details are set out in Table VI. Oil fuel bunkers taken by vessels engaged in the foreign trade, including fishing vessels, amounted to 912,725,000 gallons in 1954 compared with 857,618,000 gallons in 1953.

TABLE V

U.K. PETROLEUM IMPORTS BY ZONES OF CONSIGNMENT

	1954		1953		1952	
	Mil gal	*% of total*	*Mil gal*	*% of total*	*Mil gal*	*% of total*
Middle East	6,410	70.8	6,255	71.5	5,543	68.1
Caribbean and Peru	1,659	18.4	1,287	14.7	1,128	13.9
United States	357	3.9	403	4.6	453	5.6
Europe	312	3.5	267	3.1	338	4.2
Undisclosed areas	302	3.3	538	6.2	671	8.2

Exports of Home-produced Oils

In 1954 exports of petroleum products manufactured in the U.K. were 6 per cent higher than in 1953, the corresponding value being about 15 per cent higher. Including the semi-solid and solid products, as shown in Table VII, the value was higher in 1954 by nearly 10 per cent.

Average unit values for these exports were, in pounds per 1000 gallons: motor spirit £51.6 (£51.5 in 1953); kerosine, £47.3 (£50.9); gas oil, £41 (£42.5); diesel oil, £38.3 (£36.8); fuel oil, £26.7 (£27.7); lubricating oil, £156.6 (£162.1); in pounds per cwt: lubricating compounds, £3.7 (£4); mineral jelly and wax, £6.3 (£3.1); and in pounds per ton: pitch, £10.6 (£11.7); bituminous asphalts, £23.9 (£26.8).

TABLE VI

U.K. RE-EXPORTS OF IMPORTED PETROLEUM

	1954	1953	1952
	Thousand gallons		
Motor spirit	10,983	5,483	3,160
Kerosine	3,042	8,233	1,406
Lubricating oil	1,317	1,062	1,296

TABLE VII

U.K. EXPORTS OF HOME-PRODUCED AND HOME-MANUFACTURED PETROLEUM

	1954		1953		1952	
	Quantity 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £	*Quantity* 1000 *gal*	*Value* £
Motor spirit	449,865	23,203,638	310,955	16,013,066	109,833	6,131,503
Other spirit	8,771	656,845	16,730	909,625	5,478	381,244
Kerosine	59,127	2,795,011	41,096	2,090,969	29,913	1,635,671
Gas oil	250,296	10,268,282	250,740	10,673,821	94,846	4,427,141
Diesel oil	108,071	4,142,646	136,079	5,012,071	139,737	5,647,087
Fuel oil	974,492	26,074,373	1,018,485	28,262,000	875,557	25,361,607
Lubricating oil	61,097	9,571,001	45,423	7,343,339	46,981	8,395,941
Other petroleum, crude or refined, not elsewhere specified	27,645	1,799,490	9,331	759,123	2,616	423,237
	1,939,364	78,511,286	1,828,839	71,064,014	1,304,961	52,403,431
	Cwt		*Cwt*		*Cwt*	
Lubricating compounds	352,305	1,317,006	271,599	1,079,071	308,084	1,270,334
Mineral jelly and paraffin wax	9,339	59,085	51,314	160,181	12,733	89,501
	Tons		*Tons*		*Tons*	
Pitch (other than natural asphalt and bitumen)	260,152	2,765,323	268,109	3,146,277	360,020	3,929,282
Bituminous asphalts (manufactured) and emulsions (other than for use as paint), and cable impregnating composition	66,736	1,596,708	49,898	1,337,292	77,815	1,886,784
Total of Class C, Division 2	—	£84,249,408	—	£76,786,835	—	£59,579,332

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What is a Still?

This point of terminology was discussed before the Lands Tribunal in a long and interesting case* (the hearing took six days) heard before it last year, and in which its decision was reported in December 1954. The point at issue was the liability to rates of the topping unit, and of ancillary plant, at Kent Oil Refinery. If the topping unit had been a "still" it would have been rateable as a whole, as it would if it had been a building or structure. After hearing expert evidence (including that of the President of the Institute) and consulting works of reference, such as the Oxford English Dictionary, the Tribunal decided that a topping unit was not a still.

The Tribunal also held that it was not a building or structure, as it considered such description inappropriate to a number of separate items of plant, spread over an area of about a sixth of an acre and inter-connected by pipes.

The status, from the point of view of rateability, of other petroleum refinery equipment such as heat exchangers, crude settlers, coolers, condensers, strippers, etc., was likewise considered and decided in the same case.

The report of the case, which occupies eleven pages, contains a detailed description of all the plant involved and of its function and is well worth reading, both for its intrinsic interest and also as valuable guidance concerning the application of the Plant and Machinery (Valuation for Rating) Order, 1927, to a modern petroleum refinery; the difficulties of applying an enactment of this date to plant of a type not in existence when it was drawn up were commented upon by the Tribunal, with a suggestion that revision of the Order was overdue.

V. B.

* *Kent Oil Refinery Ltd.* v. *Walker (Valuation Officer).* (1954) 47 R. & I.T. 771.

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Members of BIMCAM who attended the Association's 11th Annual Luncheon in London recently. Left to right: *H. W. Arkell, Chairman: Sir Edward Boyle, Bart., M.P.: H. W. Blake, President: Sir Roger Duncalfe: W. G. Ardley, Founder of BIMCAM: and K. T. Spencer, chief scientist, Ministry of Fuel and Power.*

S.t.s. "Vexilla" Takes the Water

Launching Speech gives news of Gas Turbine Developments

The first of six 31,000-dwt oil tankers being built in the United Kingdom for Shell was launched at Birkenhead early this year. The vessel was the s.t.s. *Vexilla*, built by Cammell Laird and Co. Ltd. and launched by Mrs J. A. Boyd-Carpenter, wife of the Rt. Hon. J. A. Boyd-Carpenter, M.P., Minister of Transport and Civil Aviation.

S.t.s. *Vexilla* is the first of eleven vessels of the same class which are under construction in European shipyards. Five of these are being built in Britain, four in France and two in Holland. A special feature in the design of the new vessels is the omission of the main mast and the substitution of a signal mast above the bridge house.

A Shell photo

S.t.s. "Vexilla" being towed to the fitting-out basin of Cammell Laird and Company (Shipbuilders and Engineers) Ltd. of Birkenhead. In the background (left) *is another new Shell tanker, s.t.s. "Hemiglypta", which is nearing completion.*

In a speech following the launching ceremony, J. W. Platt, a managing director of the Royal Dutch Shell Group of companies, spoke of the present tendency to over-emphasize the importance of size in tankers. The *Vexilla* by general standards was a large tanker, though by no means one of the largest in the world. Other factors, however, were equally as important as size in the composition of a tanker fleet. The ships of the Group's tanker fleet were designed for specific work and the fleet could not operate efficiently if it did not have ships of 9000, 12,000 and 18,000 deadweight tons as well as super tankers.

Mr Platt went on to refer to one "progressive novelty" in the construction of the *Vexilla*. The size of the centre tanks and the wing tanks of the vessel had been adjusted so that the discharge of cargo and the loading of water ballast could proceed simultaneously. The ballast was contained in tanks which, under natural operating conditions, would not be used for heavy petroleum products. This was one more step, said Mr Platt, in the elimination of delays and the most efficient use of tonnage.

Marine Gas Turbine Development

Mr Platt turned next to Shell's plans for the development of marine gas turbine engines and spoke of the way in which these were taking shape.

Designers of ships' engines faced two problems, said Mr Platt, the need to achieve fuel economy, because fuel costs were one of the heaviest and most fluctuating items in the operation of ships, and the need to reduce the weight of propulsion machinery and the space which it occupies. Taking the view that the present types of machinery did not give the same scope for improvement in these aspects as the gas turbine appeared to do, the Royal Dutch Shell Group had given its attention to the development of this new form of propulsion.

One other factor with regard to the gas turbine engine was particularly worthy of mention. Wear and tear in machinery was materially due to vibration and reciprocating motion. If it were possible to substitute simple rotary motion, the machine must surely last longer and need less attention and repair. Already Shell's experience had established that the gas turbine was vibration-free and, furthermore, tended to damp vibration from other sources.

"Auris" Experiments

In 1949, said Mr Platt, the first gas turbine unit was installed in the *Auris*, Shell's experimental vessel. Plans had been made for a new 18,000-ton tanker to be powered exclusively by a single gas turbine unit, but the pace of gas turbine developments had recently accelerated both in the United Kingdom and America, and it had been decided to omit this intermediate stage. Instead of building a gas turbine unit into a new ship, the *Auris* was now to be stripped of all its present machinery and powered by a single 5500-h.p. gas turbine engine of improved performance and design. At the same time the problem of direct mechanical transmission was being tackled and, with the help of others, a form of direct gearing coupled to a fixed propeller was being designed. It was hoped that this new plan would lead fairly quickly to the prototype of the ideal unit.

A Shell photo

Before the launching (in the foreground, left to right): *J. H. Kirby (director, Shell Tankers Ltd.), Mrs A. S. C. Hulton (wife of A. S. C. Hulton, managing director, Shell Tankers Ltd.), J. W. Platt (chairman, Shell Tankers Ltd., and a managing director of The Anglo-Saxon Petroleum Co. Ltd.), Mrs Boyd-Carpenter, and The Rt. Hon. J. A. Boyd-Carpenter, Minister of Transport and Civil Aviation.*

Notes of the Month

A.I.Ch.E. Annual Meeting

Over fifty scientific papers were presented at the 47th annual meeting of the American Institute of Chemical Engineers held in New York from 12 to 15 December last year.

Delegates to the meeting were welcomed by the President, C. G. Kirkbride, who in his opening address spoke of the importance of the accomplishments of the chemical engineer. The lay person knew too little of the chemical engineer's contributions to life today, said President Kirkbride, and there was a general misconception about chemical engineering.

Speaking of the advantages derived from a free meeting such as the A.I.Ch.E. had organized, Dr Kirkbride said that as long as a free exchange of scientific and technical information was maintained in America no other nation could match her in engineering competence.

After the annual business meeting of the Institute, two symposia were held, one on business organization for the chemical industry and another on gas absorption.

Among the speakers were the Honourable Sinclair Weeks, U.S. Secretary of Commerce, and Dr Manson Benedict who is in charge of planning for the Massachusetts Institute of Technology nuclear research reactor.

Annual Awards Banquet

The William H. Walker award, commemorating the memory of the late W. H. Walker—a pioneer in the modern concept of chemical engineering—was received by E. R Gilliland, Professor of Chemical Engineering at Massachusetts Institute of Technology, at the Annual Awards Banquet held during the annual meeting of the Institute.

Professor Gilliland is an authority on separation processes and applied industrial capacity and has been given this award in recognition of his publication record over the past few years.

Recipient of the 1954 Professional Progress Award in Chemical Engineering was J. R. Bowman, director of research at the Mellon Institute for Industrial Research, Pittsburgh. The award was in recognition of "distinguished services to the science and profession of chemical engineering by bringing to it skills of other scientific and mathematical disciplines and by showing how these powerful tools can be put to work in the solution of chemical engineering problems".

"Esso Exeter"

Esso Exeter, last of a series of 26,650-dwt supertankers commissioned from British yards by Esso Petroleum Co. Ltd., was launched from the Naval Yard of Vickers-Armstrong Ltd., Walker-on-Tyne, early in January.

The launching ceremony was performed by Mrs H. C. Tett, wife of H. C. Tett, a director of the Esso Petroleum Company.

Esso Exeter will transport crude oil from the Middle East to Esso's Fawley refinery. She will have a service speed of 16 knots and will be able to load and discharge her 24,000-ton cargo at a rate of 3000 tons an hour.

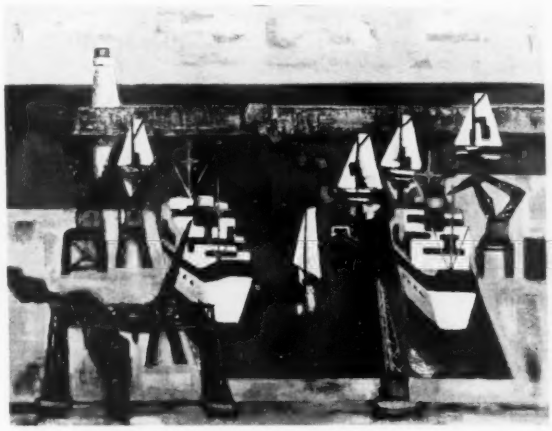
At a luncheon following the launch, Mr Tett spoke of the carrying capacity of a modern supertanker. "Each cargo of crude petroleum she brings from the Middle East," he said, "will make, among other products, enough petrol to drive all the cars in Britain 20 miles—enough diesel fuel to run the Newcastle bus fleet 30,000 miles—airplane fuel to fly once round the world all the BEA fleet of Vickers Viscounts, and fuel oil which could provide all the domestic electricity requirements of Newcastle for four months."

Speaking of the need for more heavy fuel oil for industry, Mr Tett said that it was impossible to double manufacture of that commodity without a large increase in the demand for petrol. The improvement of the roads, promised by the Government, could probably do more than anything else to help the oil industry in this respect.

Art and the Petroleum Industry

During January an interesting exhibition was held in London of recent drawings and paintings of the oil industry in five European countries.

The exhibition was entitled "The Artist's View of an Industry" and it was held at the Galleries of the Royal Society of Painters in Water Colours.



A Shell photo

"La Port" by Valezy (France).

The pictures shown in the exhibition were painted at the invitation of The Shell Petroleum Co. Ltd. and certain of its associated companies in Europe. Over 50 artists took part in the exhibition and 90 pictures in all were exhibited.

Walkie-talkie Equipment at Purfleet

Movement of petroleum products at the Shell-Mex and B.P. installation at Purfleet, Essex, is being speeded up by the use of walkie-talkie equipment.

At this installation tankers discharge their cargoes into storage tanks ashore for redistribution, and many ships are bunkered.

The radio equipment, which is being used in a number of ways to promote efficiency, consists of a master receiving set—installed at the office at the end of the jetty—and two walkie-talkie sets. The operator's set is strapped to him. It has its own aerial, works on dry-cell batteries, and weighs only 10½ lb.

Dipper checkers, whose job it is to warn tanker personnel

when to stop pumping oil into a storage tank, now use the walkie-talkie to connect them from their tank-top positions to the jetty. Formerly, a considerable safety margin had to be allowed to ensure that a tank did not overflow, as the checker had either to climb down from the tank and communicate with the jetty by means of the nearest telephone or, if this was too far away, to signal by hand or with hand lamps in the dark—a difficult and unsatisfactory method of communication.

The radio equipment is also used to speed stock-taking activities—levels in all tanks are recorded once a month and this was formerly a very lengthy task.

The cargo tanks of ships wishing to bunker are subject to inspection for cleanliness before delivery is made and it has been found that use of the walkie-talkie can save the installation's shipping supervisor from having to wait hours for ships to come in. Now he can take a set home and need not turn out until the jetty staff inform him that he is needed.

Yet another advantage of the new system is that it can be used to communicate with tankers anchored in mid-stream before berthing.

Refinery Expansion and Consumption Trends

The main trends in the European oil industry since early 1953 are summarized in the "1954 Interim Report on Oil Refinery Expansion and Consumption Trends" issued by the Organization for European Economic Co-operation.

Statistics are given for 1952 and 1953 and estimated figures are given for 1954, 1955, and 1956.

The report contains the following sections: consumption—inland and bunkers; analysis of consumption in 1952 and 1953—inland transport, agriculture, domestic and commercial lighting and space heating, industry; refining—capacity, output, throughput, and indigenous production; imports and exports of refined products; conclusions.

Extensions to Sulphur Plant

Production of sulphur at Shell's sulphur extraction plant at Jumping Pound, Alberta, Canada, has been increased to 80 tons a day, almost treble the plant's former capacity. To make this increase possible extensions costing $500,000 have been carried out.

This increase in sulphur extraction capacity is in line with the recent $1,500,000 expansion of Shell's natural gas facilities in this area. Before natural gas can be marketed, the sulphur which it contains in the form of hydrogen sulphide must be removed. When natural gas was first discovered in Alberta in 1944 it was not immediately developed. By 1950, however, gas was being supplied on a commercial scale to communities in Southern Alberta, and since November 1954 the plant has been producing 60 million cubic feet of gas per day.

The sulphur extracted from the gas is itself a valuable marketable product. Pulp and paper manufacturers have previously been the purchasers but now a considerable quantity is to be taken to the Gunnar Mines at Beaver Lodge on Lake Athabaska, Saskatchewan. There it will be converted into sulphuric acid and used in the processing of uranium ores which are being mined in that district.

Symposium on Applied Geophysics

A Symposium on Applied Geophysics is to be held in the Department of Mining, University of Leeds, from 15 to 18 March. Admission to the lectures is free of charge.

Full details of the programme are obtainable from the University.

New Canadian Subsidiary

Le Grand, Sutcliff, and Gell Ltd., well drillers and oilfield equipment manufacturers, have recently formed a Canadian subsidiary, Legrand Ltd., with headquarters in Calgary, Alberta, for the supply and distribution of its products to the Canadian oil industry.

S. C. Cook, M.Inst.Pet., has been appointed vice-president and general manager of the Canadian Company.

German Oil Production

Total production of crude petroleum in Germany in 1954 was 2,665,856 metric tons, an increase of about 477,000 tons (21.8 per cent) over the 1953 total. In arriving at this total, *Erdöl-Informationdienst* has estimated the December 1954 output to be 242,136 metric tons. Details by fields are:—

	1953	1954
	Metric tons	
Emsland . . .	874,068	1,030,527
Weser-Ems . . .	167,458	318,983
Hanover . . .	923,192	985,053
Holstein-Hamburg . .	187,799	262,444
Oberrheintal . .	36,166	68,539
Bayern . . .	13	310
	2,188,696	2,665,856

Oil at Plungar

Oil has been found at a depth of about 2840 feet at Well No. 7 in the Plungar, Leicestershire, oilfield which is being developed by The British Petroleum Company's D'Arcy Exploration Company.

A Shell photo

The oil gas recovery plant at Jumping Pound. On the extreme left are the heater converters of the sulphur plant; left centre, is the boiler house with its fire stacks rising in the background; and to the right are the processing towers which recover natural gasoline and prepare the natural gas for use.

Wells 1, 2, and 6 are already producing oil and drilling has begun at Well No. 8. Preparations are also in hand for three further wells.

The D'Arcy Company has also begun to drill an exploratory test well at Chaldon Herring, Dorset.

Whessoe Extensions

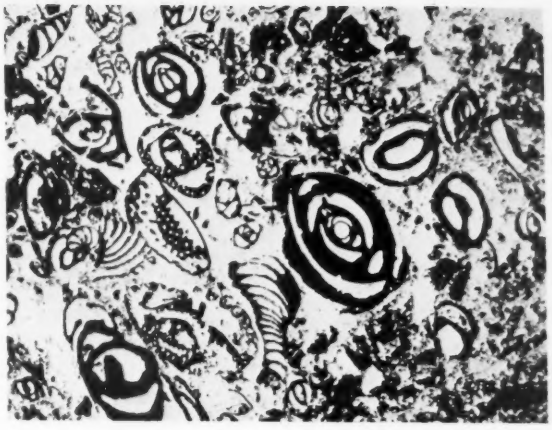
Part of a large new pickling and painting shop has recently been brought into operation by Whessoe Ltd., marking the completion of a works reconstruction programme which has entailed an expenditure of £1,000,000 since 1946.

The pickling of mild steel plates and sections used in plant for the oil, gas, chemical, and other heavy industries has greatly expanded since 1934, when Whessoe first undertook this process, and 80 per cent of the Company's total products are now treated in this way.

U.K. Oil Equipment Exports

Exports of mineral oil-refining machinery from the U.K. in 1954 were valued at £2,742,332 compared with £2,302,099 in 1953.

The value of the oil fuel burning equipment exported in 1954 was £743,601, the corresponding figure for 1953 being £598,820. Exports of domestic grates and stoves for burning liquid fuel were valued at £1,233,810 in 1954 and £1,020,424 in 1953.



A B.P. photo

A thin section of miliolid limestone magnified 100 times at The British Petroleum Company's Palaeontological Laboratory in London. Every year the Company's geologists send thousands of fragments of rock to the Laboratory where their oil-bearing possibilities are assessed.

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Conference on Combustion

Bearing in mind the inherent difficulty in applying theory to practice in the sphere of combustion, The Institution of Mechanical Engineers, in collaboration with the American Society of Mechanical Engineers, has organized a Conference on Combustion. The objects of the Conference will be (i) to link theory and practice by presenting the results of theoretical work to practical engineers, and (ii) to provide an opportunity for practical engineers from many countries to meet and discuss practical applications of theory.

About half of the papers are being provided by the ASME, the remainder being from Britain or Europe. All the papers will first be presented at a meeting in Boston, Mass., U.S.A., on 15-17 June 1955 and then in London, in the Great Hall of The Institution of Civil Engineers, on 25-27 October 1955. In London there will be five sessions devoted to the papers themselves and a concluding general session. Papers will be presented for discussion in abstract form by reporters and, if time permits, authors may be able to reply briefly to comments. Full replies will be published in the Proceedings.

Details of the papers and the London arrangements are:

List of Papers to be presented for Discussion in Boston and London

Section I—General. (25 October, morning)

‡ The Application of Scientific Principles to Combustion Practice. By B. M. Lewis.
‡ An Appraisal of Combustion Research. By R. A. Sherman and W. T. Reed.
† Chemistry and Physics of Combustion. By Sir Alfred Egerton, M.A., D.Sc., F.R.S., Professor O. A. Saunders, M.A., D.Sc., M.I.Mech.E., and D. B. Spalding, M.A., Ph.D.

Section II—Boilers. (25 October, afternoon)

‡ Some Methods for the Disposal and Elimination of Petroleum Refinery Waste Gases. By O. F. Campbell.
‡ Instruments as Applied to Detection of Flame Failure. By W. D. Stevens.
‡ Developments of Furnaces for Burning Low-grade Bituminous Coals. By Otto de Lorenzi.
‡ Firing Methods *versus* Fuel Properties. By R. C. Corey.
‡ Burning Canadian Midwestern Coals.
† Boiler Availability—A Commentary. By H. E. Crossley, Ph.D., and W. G. Marskell, B.Sc.
† Liquid Fuel Firing. By R. P. Fraser, O.B.E.
† Combustion of Pulverized Fuel for Steam Generation. By W. F. Simonson, M.I.Mech.E.
† Spreader Stokers and Combustion. By N. Platt.
† The Development and Practice of Cyclone Firing in Germany. By H. Seidl.

Section III—Industrial Furnaces. (26 October, morning)

‡ High-temperature Gas Jets as applied to some Manufacturing Processes. By James B. Henwood.
‡ High-speed Heating with Emphasis on Jet Combustion. By Fred Hess.
‡ The Status of Combustion in Industrial Furnaces. By Dr J. J. Turin and J. Huebler.
‡ Instruments as Applied to Product Improvement in Steel Furnaces. By J. W. Percy.
‡ Gas as a Source of Protective Atmosphere in Industrial Furnaces. By E. J. Funk, Jr.
‡ Combination Oil and Gas Burners for Industrial Furnaces. By C. W. Hanlon.
‡ Instrumentation of Process Tubular Heaters. By L. A. Mekler.
† Combustion and Heat Transfer in the Open-Hearth Furnace. By J. H. Chesters, D.Sc., Ph.D., M. W. Thring, M.A., and S. W. Pearson.
† Design of Burners for Open-hearth Furnaces. By M. P. Newby, B.Sc., G. R. Mattocks, Ph.D., and M. J. McInerney.
† Combustion and Thermal Transfer in Continuous Reheating Furnaces. By H. Southern, A.M.I.Mech.E., D. Smith, B.Sc., Ph.D., and F. A. Gray.
† Combustion and Heat Transfer in Glass Tanks. By H. R. S. Jack, Ph.D., B.Sc., A.M.I.Mech.E., S. Krusewski, and D. A. Richardson, B.Sc.
† Advances in Cupola Combustion. By G. A. H. Jungbluth and K. Roesch.

Section IV—Internal-Combustion Engines. (26 October, afternoon)

‡ Surface Ignition in a Motored Engine. By J. C. Livengood, T. Y. Toong, T. P. Rona, C. F. Taylor, and I. A. Black.
‡ High-compression Turbo-charged Spark-ignition Gas Engines. By W. F. Kauffmann.
‡ Combustion on Pre-combustion Chamber Engines. By Arthur Rosen.

‡ Indicates North American paper.
† Indicates British or European paper.

‡ Combustion Reactions in Gasoline Engines. By Professor Karl Stinson.
† Combustion in Large Diesel Engines. By P. Jackson, M.Sc., M.I.Mech.E.
† Combustion in Diesel Engines with Divided Combustion Chambers. By H. Lang, H. Hoffman, and Dr O. Cordier.
† Combustion Products and Wear in High-speed Compression-ignition Engines, with Particular Reference to the Use of Lower Grade Fuels. By W. T. Lyn, Ph.D., M.Sc.(Eng.), A.M.I.Mech.E.
† Combustion in Petrol Engines. By R. Vichnievsky, D.Sc., M.I.Mech.E.
† Combustion in Dual-fuel Engines. By N. P. W. Moore and R. W. Stuart Mitchell, M.Sc., M.I.Mech.E.

Section V—Gas Turbines. (27 October, morning)
‡ Application of Electronic Probes to Measurements of Turbulent Flames. By Béla Karlovitz.
‡ Iridium *versus* Iridium-Rhodium Thermocouples for Gas Temperature Measurements up to 3,500 F. By C. R. Droms and A. I. Dahl.
‡ Combustion of Blast Furnace Gas in Gas Turbines. By A. E. Hershey.
‡ Coal Firing for the Open-cycle Gas Turbine—A Comparison of Methods. By H. R. Hazard.
† The Relation of Specific Heat Release to Pressure Drop in Aero-gas-turbine Combustion. By Dr J. S. Clarke, O.B.E., B.Sc., M.I.Mech.E.
† Combustion Chambers and Control of the Temperature at which they Operate. By W. Tipler, M.A.
† The Use of Solid Fuels in Gas Turbines. By T. F. Hurley, O.B.E., B.Sc., and W. V. Battcock.
† Combustion of Residual Fuel in Gas Turbines. By Dr P. T. Sulzer and I. G. Bowen.
† Operating Experience with Combustion Equipment in Industrial Gas Turbines. By C. Kind.
† Application of Research to Gas Turbine Combustion Problems. By R. P. Probert.

Section VI. (27 October, afternoon)
General Session at which short summaries of the discussions at each of the Specialist Sections will be presented.

‡ Indicates North American paper.
† Indicates British or European paper.

Advance copies of the papers will be published by The Institution of Mechanical Engineers and are expected to be available early in April. Cost of the bound volume of Proceedings plus a set of preprints will be £2 12*s.* 6*d.* if ordered before June. The preprints alone will be 15*s.* 0*d.* per set, and the Proceedings, if ordered after the Conference, £2 5*s.* 0*d.*

The Conference will be open to members of all participating institutions and societies and details are to be circulated later.

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Forthcoming Meetings

THE INSTITUTE
(At 26 Portland Place, London, W.1, 5.30 p.m.—tea 5 p.m.)

Refining Methods for Maximizing Middle Distillate Production. L. S. Bonnell. **13 April**

IP FAWLEY BRANCH
(At Esso (Fawley) Recreation Club, Holbury, 7.30 p.m.)

The Oil Industry in World Economy. M. E. Hubbard, B.A., M.I.Mech.E. **18 March**
Farnborough Air Displays. R. Dù Cane. **15 April**

IP LONDON BRANCH
(At 26 Portland Place, London, W.1, 6 p.m.—tea 5.30 p.m.)

The Manufacture and Use of White Oils and Sulphonates. T. F. Brown, Ph.D., A.R.T.C., A.M.I.Chem.E., F.R.I.C. **22 March**
Petroleum and Fire Prevention—Some Special Considerations. J. H. Burgoyne, D.Sc., Ph.D., A.R.C.S., D.I.C. **20 April**

IP NORTHERN BRANCH
(At Engineers' Club, Albert Square, Manchester 2, 6.30 p.m.)

Symposium on the Lubrication of Transport Fleets. Chairman: A. T. Wilford, B.Sc., F.R.I.C., M.I.Mech.E. **15 March**
Drawing Oils and Lubricants. A. B. Ashton, M.Sc., F.I.M. **19 April**

IP SOUTH-EASTERN BRANCH
(At King's Head Hotel, Rochester, 7.45 p.m.)

Electricity in Hazardous Atmospheres. A. Chatting. **5 April**

IP STANLOW BRANCH
(At the Grosvenor Hotel, Chester, 7.30 p.m.)

Platforming. **16 March**
Engineering in Chemical Plants. O. W. Murray. Joint meeting with The Institution of Chemical Engineers and the Society of Chemical Industry. 7 p.m. **13 April**

ECONOMICS AND OPERATIONS GROUP
(At 26 Portland Place, London, W.1, 5.30 p.m.—tea 5 p.m.)

Trends in Motor Vehicle Population and their Effects on Petroleum Consumption. W. A. C. Strugnell. **19 April**

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THE OIL INDUSTRY—ITS PLACE IN THE WORLD AND ITS FUTURE

It is regretted that J. W. Platt will be unable to deliver his paper on the above subject on 13 April as announced. Arrangements are being made for him to read it on Wednesday 12 October.

Therefore, on 13 April a paper by L. S. Bonnell (Esso Research and Engineering Company) on "Refining methods for maximizing middle distillate production" will be read at 26 Portland Place, London, W. 1 at 5.30 p.m. After discussing European, U.S.A., and Canadian operations in this sphere. Mr Bonnell will deal with process developments to improve middle distillate yields.

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SITUATIONS VACANT

Air Ministry, Works Designs Branch, requires in London designer/draughtsmen for bulk petroleum storage and pumping installations experienced in one or more of following: (*a*) storage tank layout and design, (*b*) pumphouse and plant layout, (*c*) development of pipeline schemes, (*d*) hydraulic calculations. Technical training to O.N.C. standard required. Salaries up to £695 p.a., starting pay based on age, qualifications, and experience. Overtime payable. Promotion prospects and long-term possibilities. Natural born British subjects only. Write stating age, qualifications, employment details, including type of work done, to Ministry of Labour, 236 Walworth Road, London, S.E.17, quoting Order 3593/EC.

Applications are invited by the Vacuum Oil Co. Ltd., for the position of **Plant Inspection Engineer** at the Coryton Refinery, Essex. The successful applicant will be responsible for all metal inspection in the refinery with a view to improving safety and efficiency and forecasting replacements and repairs. Applicants should be between 30 and 40 years of age and possess an Engineering Degree or A.M.I.Mech.E. and have had at least five years' experience as a Plant Inspector in the oil industry. Conditions of employment include a Pension and Life Assurance Scheme, Sickness Benefit Plan, and Sports and Social Club. The successful applicant will be eligible for consideration in obtaining the tenancies of certain houses available to the Company. Applications, giving full details of qualifications and experience and quoting reference "I.E." should be addressed to the Industrial Relations Superintendent, Vacuum Oil Company Limited, Coryton Refinery, Coryton, Essex.

Petroleum Geologist required for Oil Company in Trinidad. Must be fully qualified, with Oilfield experience. Three years' Agreement, renewable if mutually satisfactory. Commencing salary according to experience. Free furnished quarters and medical attention. Leave on full pay and passages. Pension Scheme. Apply stating age, whether married or single, qualifications, and experience to Box 3106, The E.C. Advertising Co., 54 Old Broad Street, London, E.C.2.

Petroleum Engineer required for Oil Company in Trinidad. Candidate must have degree, preferably in petroleum technology, and should be not less than 25 or more than 30 years of age. Three years' agreement, renewable if mutually satisfactory. Commencing salary according to qualifications and experience. Free furnished quarters and medical attention. Leave on full pay and passages. Pension Scheme. Apply stating age, whether married or single, qualifications, and experience to Box 3109, The E.C. Advertising Co., 54 Old Broad Street, London. E.C.2.

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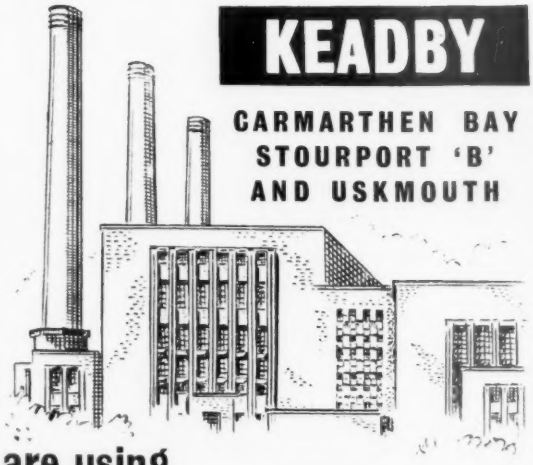

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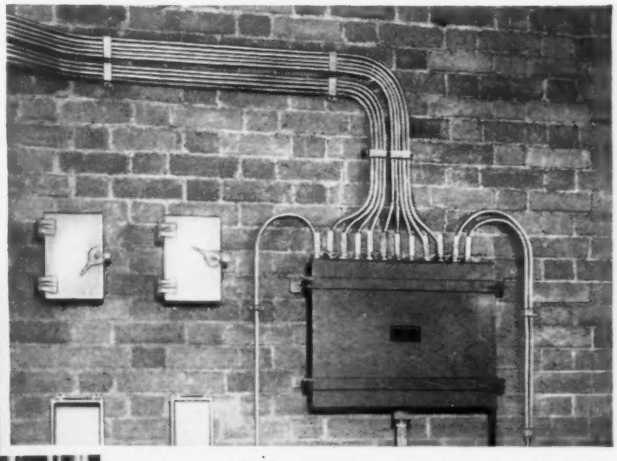

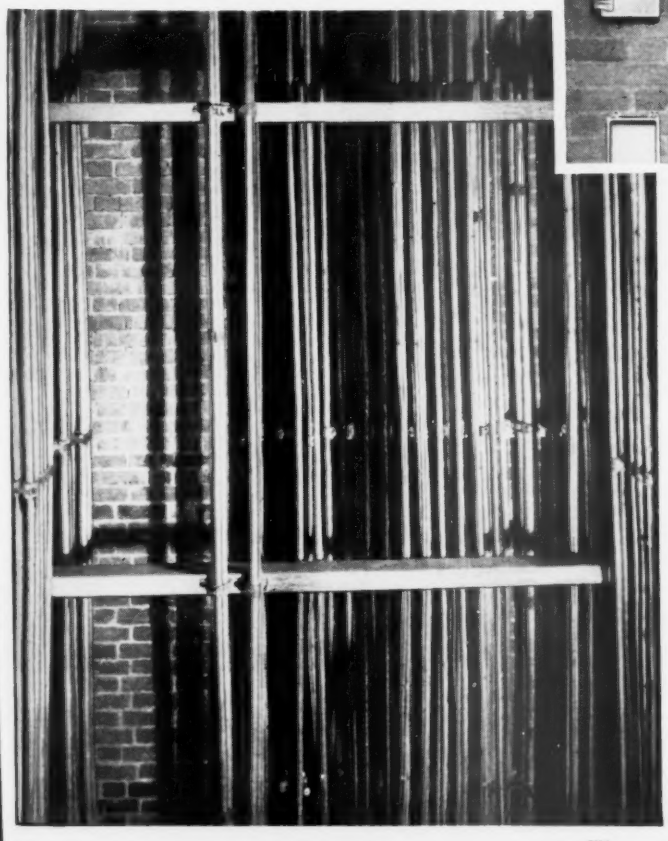

Above: Neatly installed formations of aluminium sheathed wiring cables terminating in a marshalling box.

Left: A main cable trunk at Keadby comprising 150 h.v. and l.v. cables, all but a few being aluminium sheathed.

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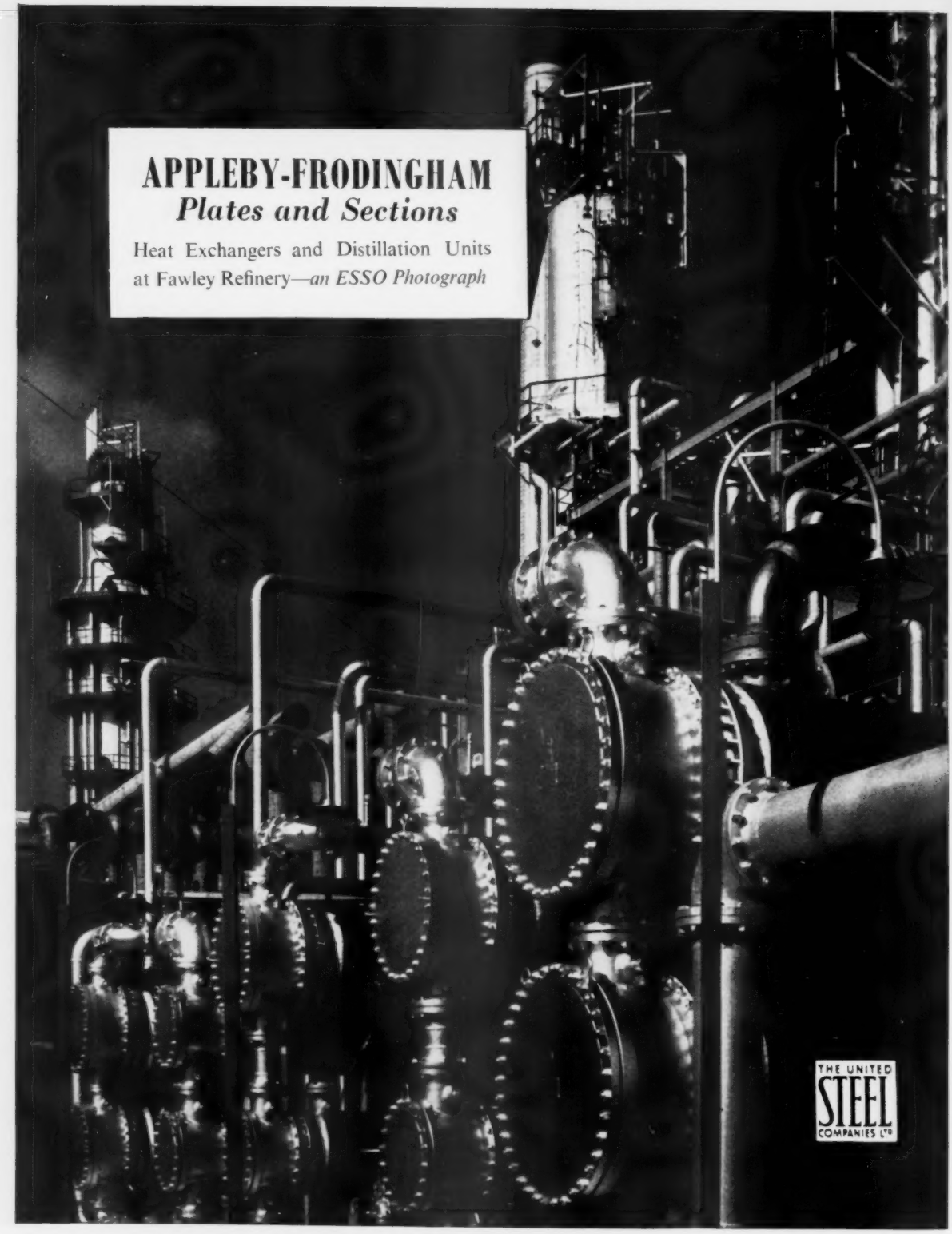

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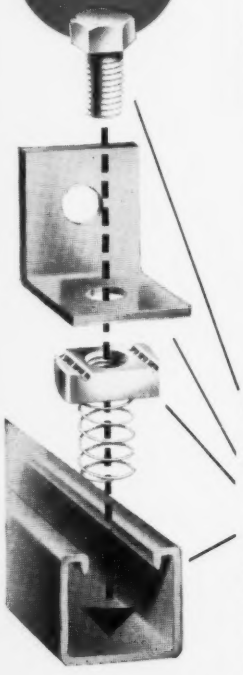

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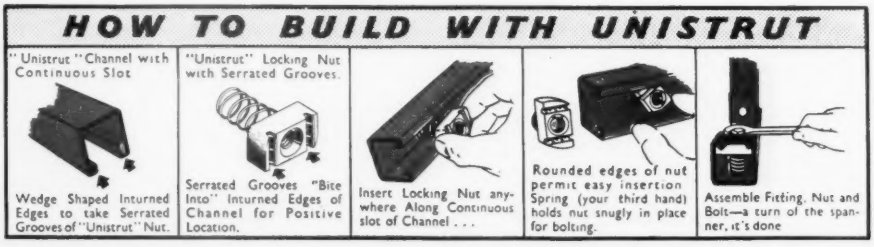
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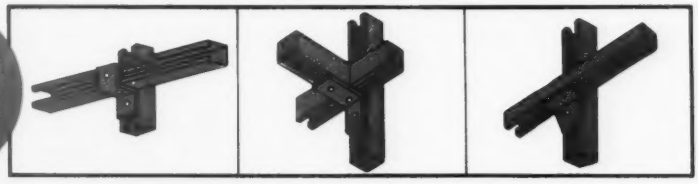
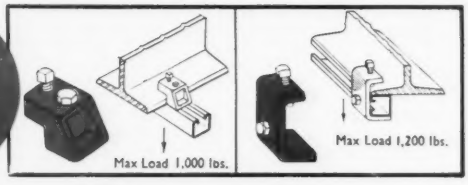
Serrated Grooves "Bite Into" Inturned Edges of Channel for Positive Location.
Insert Locking Nut anywhere Along Continuous slot of Channel . . .
Rounded edges of nut permit easy insertion Spring (your third hand) holds nut snugly in place for bolting.
Assemble Fitting, Nut and Bolt—a turn of the spanner, it's done

FRAMING FITTINGS



BEAM CLAMPS



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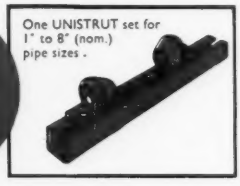

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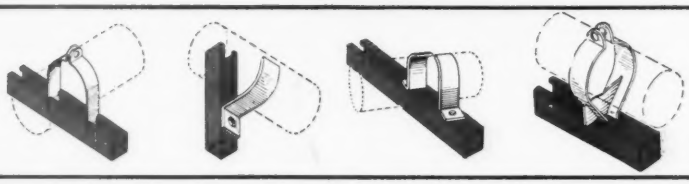
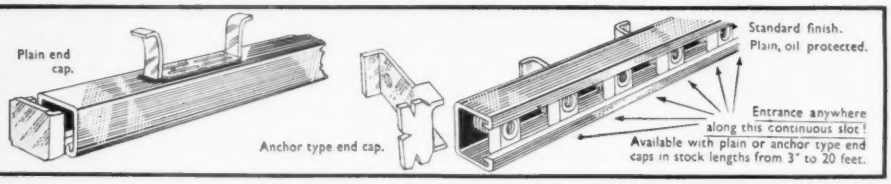


CONCRETE INSERTS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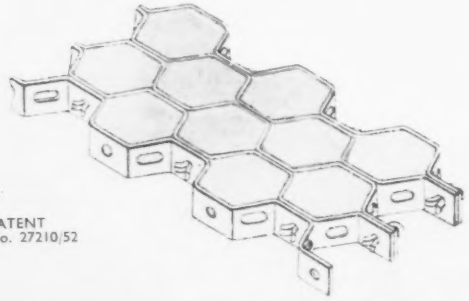

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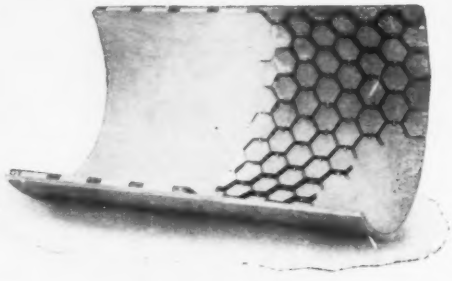

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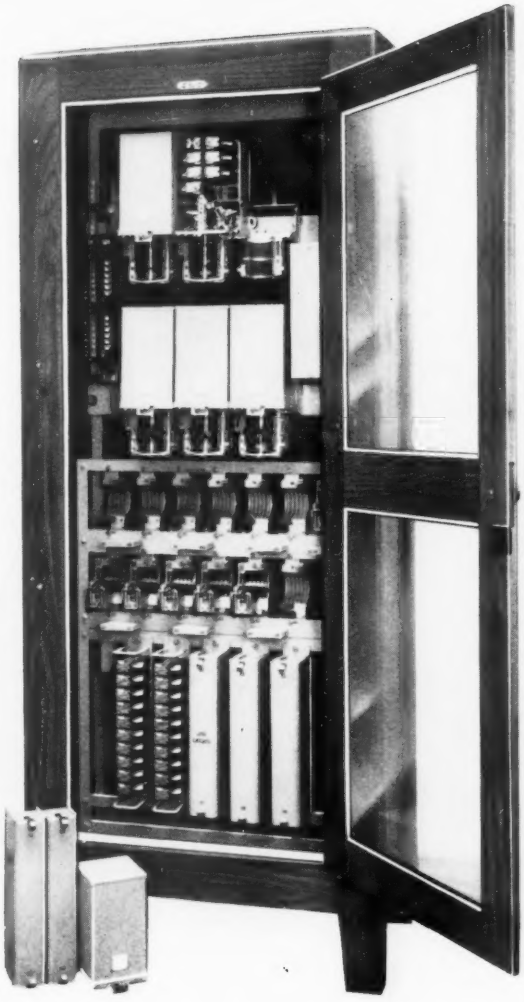

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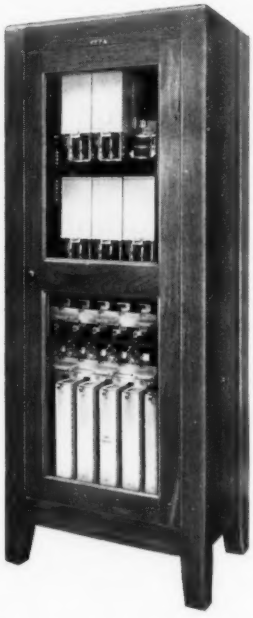

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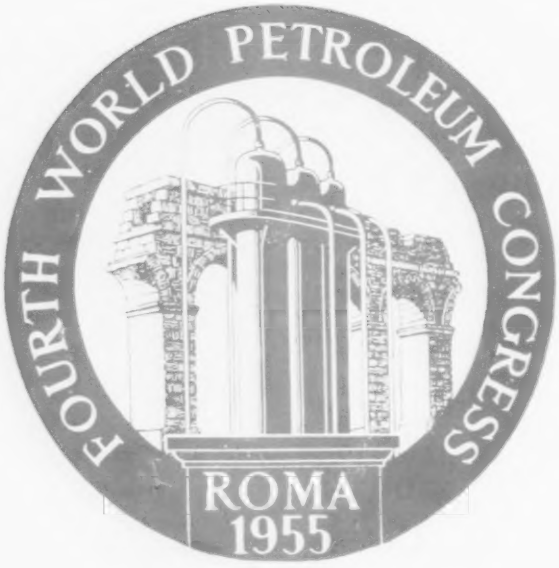

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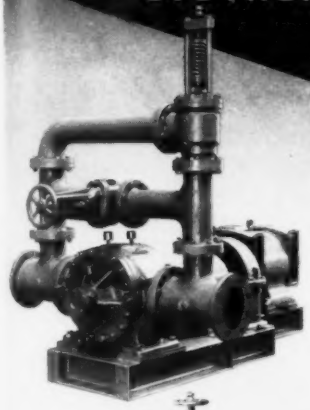

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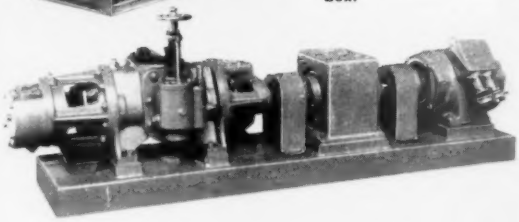
(Below)
Positive Acting Screw Displacement Spirit Pump, electrically driven through Wall Box.



(Right)
Positive Acting Screw Displacement Spirit Pump specially designed for fitting to Road vehicles.

(Below)
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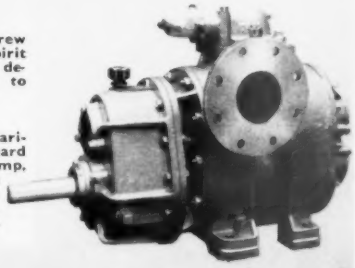

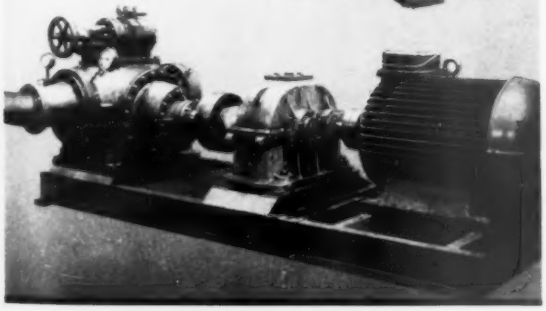

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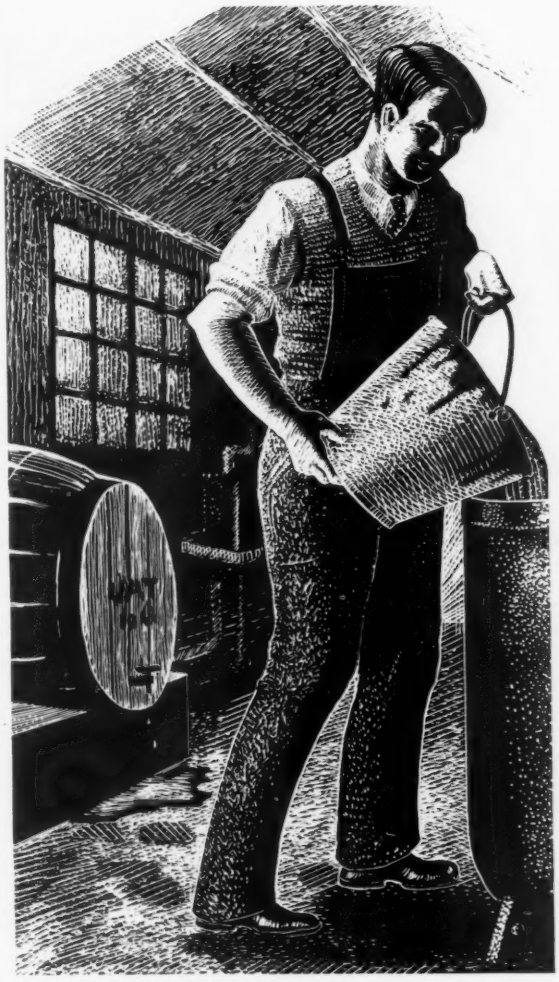

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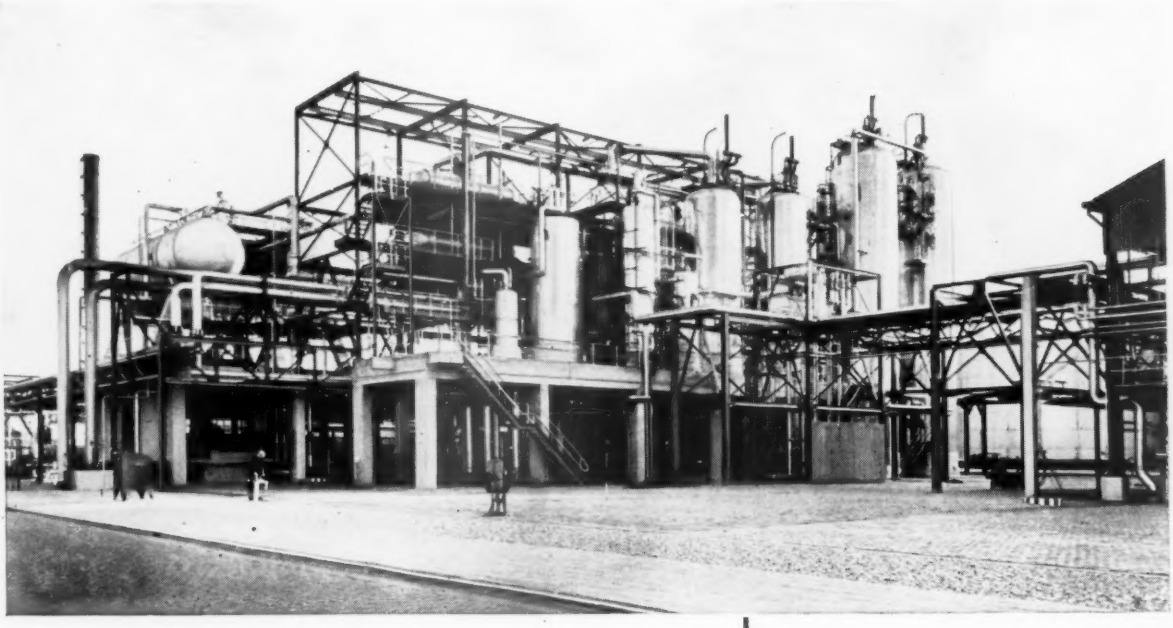

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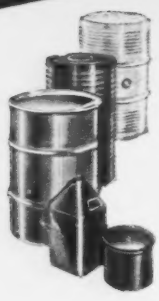

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